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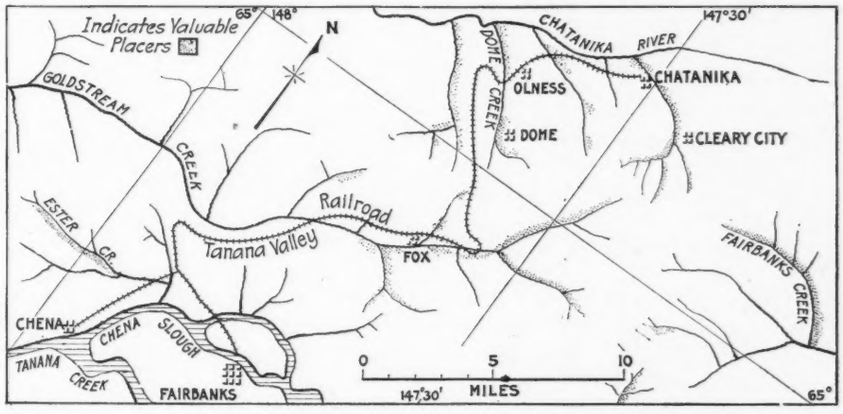
Dawson, Nome and Fairbanks

By Hubert I. Ellis*

SYNOPSIS—A brief sketch of the rise of Dawson, Nome and Fairbanks, the three famous placer camps of Alaska and the Yukon. A period of depression follows the first boom, and is in turn succeeded by a rise due to the introduction of machinery to work lower-grade deposits. The character of the gravels is described, together with the influence of various elements upon the prosperity of the industry.

Dawson, Nome and Fairbanks, named in the order of discovery, are the three world-famous placer districts of Alaska and the adjacent Yukon Territory. To these might be added Iditarod, but that camp never attracted the attention the others did. Indeed, each discovery has occasioned less excitement than the preceding. Thus Dawson aroused the wildest enthusiasm and was followed in order by Nome, Fairbanks and Iditarod, Dawson was discovered in 1896 and has produced $180,000,000; Nome was discovered in 1898 and has produced $69,000,000; Fairbanks was discovered in 1903 and has produced $63,000,000.



Sketch Map of Fairbanks District

Three Stages of Placer-Mining History

There are three distinct stages in the history of every placer-mining camp of the type under discussion. The first stage includes the wild extravagance attendant on discovery and extends through the days of the bonanzas. Money is plentiful, life moves at a rapid pace, and no one takes thought of the morrow. Then there comes a time when the failure of new discoveries to keep pace with the exhaustion of the old mines foreshadows a dwindling of production. This condition makes itself felt in the community before it is reflected in statistics of production, since profits are decreased by higher working costs and lower yield per unit of material handled before the output shows an important decline. Then the production commences to fall away and the total cost of mining approaches nearer and nearer to the total yield. The pinch of poverty becomes more than a vague possibility, an air of pessimism prevails and many of the residents become so discouraged as to leave the district.

The third stage is marked by the introduction of mechanical means for handling the gold-bearing gravel, in distinction to the crude hand methods of the early days. The prospector and the individual miner, on whom the prosperity of the district formerly depended, give way to the stock company with millions of dollars to invest in paving the way for extraction. Simultaneously, the pick, shovel and wheelbarrow are replaced by the dredge and the hydraulic giant, and hundreds of cubic yards of gravel are then moved where one was moved in former days.

Of the districts noted above, Dawson best exemplifies the working of the rule. This is brought out clearly in Fig. 1. George Carmack discovered "pay" on Bonanza Creek, a tributary of the Klondike River, in August, 1896. Robert Henderson had previously found gold in another portion of the same district, but for some reason, possibly because Henderson's discovery was scarcely rich enough to constitute "pay,"[1] Carmack is usually hailed as the discoverer of Dawson. The production increased by leaps and bounds to a maximum of $22,500,000 in 1900. That is, royalty was paid to the government on this amount. There are many, however, who maintain that the actual yield was considerably greater, much "dust" evading the vigilance of the officials and escaping the payment of royalty. From the high-water mark of 1900 the production fell away rapidly to a minimum of $3,150,000 in 1907. Since this time, thanks largely to the operations of the Yukon Gold Co., the output has gradually increased to about $6,000,000 in 1914. It may be noted that the figures quoted for Dawson include a small amount of gold from other portions of northern Yukon Territory.

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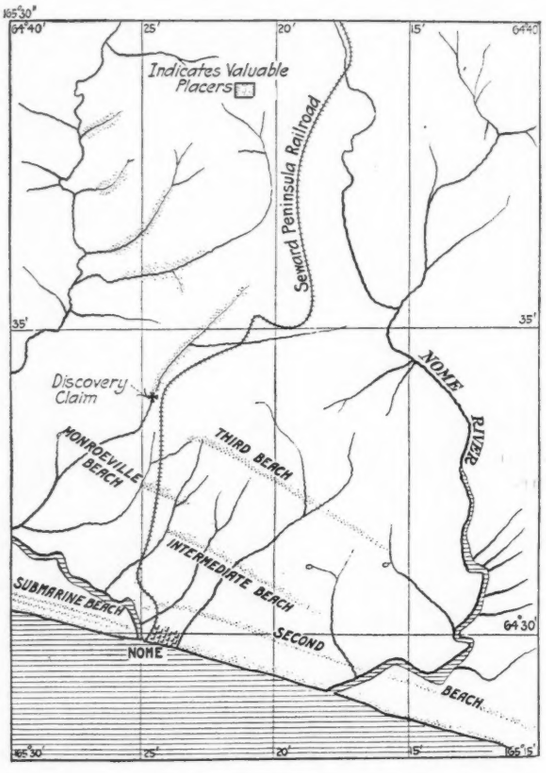
[1]The word "pay," in placer-mining parlance, is used much the same as "ore" in lode mining. The idea of profit is always more or less distinctly in mind, but it is not uncommon to hear men speak of "pay" that is too low grade to be exploited at a profit.

Rise and Fall of District Production

The curve for Nome—or Seward Peninsula, to be exact, since the production for the whole area is usually given as a lump sum—is interesting as showing the influence of the famous Third Beach. Pay was discovered in 1898 and the output jumped to $4,750,000 in 1900. Then it held about even, until the discovery of the Third Beach line in 1905 led to a greatly increased production, reaching $7,500,000 in 1906. Since then the output has fallen away, but if preliminary estimates of about $3,000,000 for 1914 prove correct, it will indicate that bedrock has been reached and that the district may be expected to hold its own for some years to come.

In the Fairbanks district, Felix Pedro discovered gold on Pedro Creek in 1902, but no important production was made until the following year. There was a stampede from Dawson, Nome, and other places during the winter



Sketch Map of Nome Mining District

of 1902-3, but conditions were so unsatisfactory that it was proposed to hang the man whose glowing reports, made on his way outside on one of the last boats in the fall, were chiefly responsible for the stampede. Fortunately the man, a Japanese named Wada, was well beyond the reach of the disappointed gold seekers. During the following summer a production of $40,000 was made, and this led to a second stampede to Fairbanks. Even then the majority left dissatisfied, and condemned the district in the strongest terms, only to return a year later when the value of the find had been amply demonstrated by the persevering few whose confidence had remained unshaken from the first.

A heavy sag will be noted in the Fairbanks curve, Fig. 1, for 1907; this was due chiefly to labor troubles. The maximum production, $9,650,000, was attained in 1909. The yield for 1914 is estimated at $3,000,000, but it is probable that this is a little high for the Fairbanks district proper, which includes only those creeks to the north of the Tanana within 30 miles of the town of Fairbanks. (See sketch map of district.)

It will be noted that production at Dawson fell away from the maximum for 7 years before it began to increase again. Curiously enough, exactly the same length of time passed at Nome from the maximum to the apparent minimum. As it is only 5 years since the maximum production at Fairbanks, analogy would indicate that the output will continue to decrease for several years yet, and this conclusion is borne out by a careful study of the dis-

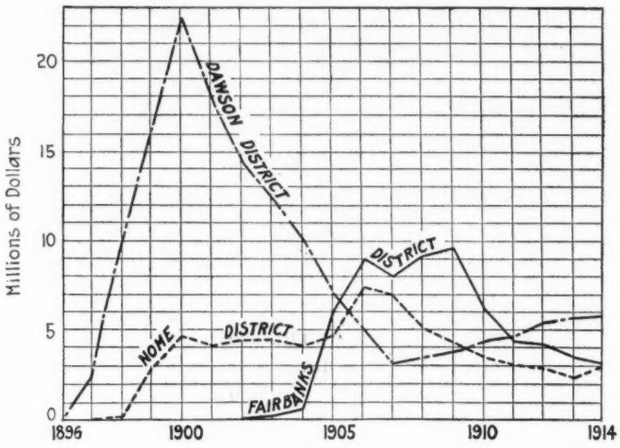


Fig. 1. Gold Production by Years

trict. Even at Nome the evidence is too meager to justify more than a pious hope that the lower limit has been reached and that the yield is now on the upgrade.

Dawson and Nome having demonstrated, more or less conclusively, their ability to "come back" by substituting mechanical handling of gravel for pick-and-shovel methods, it remains to consider the outlook for the future at Fairbanks. Since the character and situation of the gold-bearing deposits determine the possibility of mechanical methods, it seems desirable to describe briefly the occurrence of the auriferous gravels in the three districts.

Features of the Dawson Deposits

The most prominent features of the Dawson deposits are due to the fact that the present drainage has cut deep-

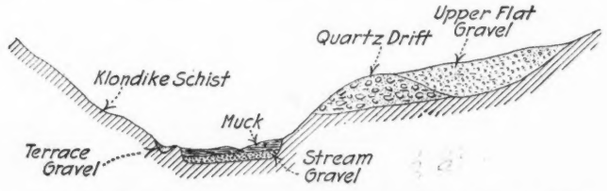


Fig. 2. Generalized Cross-Section of Bonanza Valley below Eldorado Forks

ly through gold-bearing gravel beds formed by ancient streams flowing at a higher elevation. Terrace deposits lying well above the present drainage are therefore well developed, as illustrated at Fig. 2, showing the famous White Channel quartz drift, carrying workable quantities of gold in places, and a later, barren, deposit of upper flat gravel. There are also smaller auriferous terrace deposits, or "bench gravels," lying between the White Channel and the present drainage level. The gravel in the present

stream beds is, to a great extent, a reconcentration of the products of primary concentration by the ancient river system. They are—or were before being gutted by the pioneer—astonishingly rich, pans of $500 or more being too common to cause comment. Largely owing to lack of grade, the stream-gravels offer a better opportunity for the dredge than for the giant, especially in the case of the larger rivers, such as the Klondike, where dredging is the only possible method of attack. Although the richest portions of the creeks have been worked out by crude hand methods, there is enough gold left to make excavating by mechanical means a highly profitable enterprise.

One feature that has helped the dredge and the giant is the large amount of clay or "sediment" in the pay-

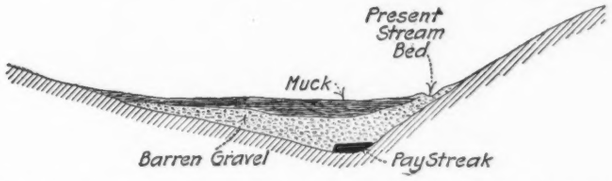


FIG. 3. SECTION ACROSS VALLEY OF CREEK AT FAIRBANKS

streaks, which prevented a thorough washing with the appliances formerly in use. This clay not only carried over the gold it originally contained, but it had a disgusting tendency to gather more in rolling down the sluice-boxes, thus "robbing the boxes," as the miners express it. Having been exposed to air, rain and frost for several years in old tailing piles, the clay now readily yields its precious metal to machines equipped with modern gold-saving devices.

Terrace deposits, the "happy hunting ground" of the hydraulic man, are not developed to the extent on Seward Peninsula that they are at Dawson. Much of the production of the district has come from the ancient beach placers, which are, in a way, a sort of terrace deposit themselves. Fig. 4 shows a cross-section of the various beaches and also the production of each up to 1911. Unfortu-

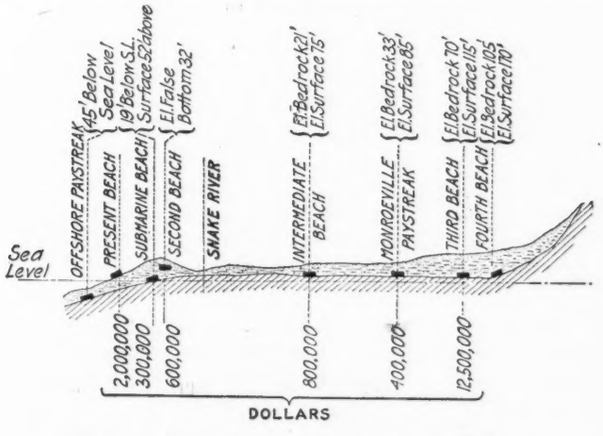


FIG. 4. SECTION OF BEACHES AT NOME
(After T. M. Gibson)

nately, detailed figures of production are not available for the last few years, but since 83% of the production of Seward Peninsula was made previous to 1911, those given show clearly the relative importance of the various beach lines.

It is evident from Fig. 4 that the beach deposits themselves offer little opportunity for dredging or hydraulicking, and their influence on the yield of the peninsula is decreasing each year. Of the forty-odd dredges on Seward Peninsula, only 11 are in the Nome district proper, the others being in the Council, Solomon, Teller, Inmachuck, Candle and Kougarok districts. It is estimated that 60% of the total output in 1914 came from dredging operations, chiefly on the placers of the present streams. Many of these are not over 6 to 10 ft. deep and carry gold throughout, so they are a favorable field for small dredges.

WORKING SYSTEMS ON THE CREEKS

A section representative of the Fairbanks district is shown in Fig. 3. The pay gravels are buried deeply beneath an overburden of muck and barren gravel. The proportion of gold-bearing gravel to the total amount is comparatively insignificant. The depth of worthless overburden varies from a few feet near the source on some of the streams to more than 200 ft. in places on Vault Creek. It is difficult to arrive at the average depth to bedrock, but it is probably not less than 50 or 60 ft. Since the "pay" is concentrated in the lower 5 ft., and in a comparatively narrow channel at that, it is evident that the ground, being permanently frozen, can be mined much more cheaply by the present method of drifting than by dredging. Owing to lack of gradient and the difficulty of obtaining a dependable supply of water, hydraulicking is obviously not to be considered.

On a few creeks, such as upper Goldstream and its tributaries, upper Cleary, and upper Fairbanks Creek, there is considerable ground shallow enough to be worked by opencut; that is, it is cheaper to remove the barren overburden than it is to "drift out" the paystreak. Much of this ground is now being mined on a comparatively large scale by means of power scrapers. A small dredge was installed on No. 8 Above, Fairbanks Creek, several years ago, but it has never been regarded as a commercial success. The dredge was recently placed under the direction of a competent engineer, however, and made a profit in 1914.

The large areas of low-grade ground on Goldstream and its headwater tributaries could probably be dredged at a profit were it possible to purchase the claims from the owners at a reasonable figure, but the disposition to play the outside capitalist for a good thing leads to the belief that most of this ground will be worked piecemeal by scraping.

The total area of shallow ground is insignificant, however, compared with the area where the depth to bedrock precludes the feasibility of dredging. The main dependence of the district always has been and always will be on drift-mining methods, whereby a vertical shaft is sunk to bedrock through the barren overburden and the pay-gravel removed by horizontal stoping. If the material lying above the paystreak carried even a small amount of gold it might be profitable to install a dredge and mine the whole deposit, but the sorting action of the streams has been so thorough that this gravel is practically barren. In opencut mining, where the top gravel must be removed anyway, it is more economical to scrape it to one side than to sluice it.

The difference in occurrence of the gold in the three districts is brought out in Fig. 5. *A* is a section on Eldorado Creek where the width of the deposit, from rim-rock to rim-rock, is 80 ft. and the depth 24 ft. The muck layer is thin, while all the gravel carries gold in paying quantities—$1 to

the pan being about $135 to the cubic yard[2]. Section *B* is representative of the Nome beaches. The greatest proportion of gold is concentrated on bedrock, but all the gravel carries important quantities.

Section *C* shows conditions at Fairbanks, with large quantities of muck and barren gravel above a thin pay-streak. As noted, there are some shallow deposits, but they are much less extensive than the deeper ones.

Future of Lode Mining

It was hoped for a time that the lode mines would be able to maintain the prosperity of the region adjacent to Fairbanks. Although these mines have made considerable progress and have produced nearly $1,000,000 to date, this hope has now been largely abandoned, and it is recognized that the salvation of the district depends on reducing the cost of drift-mining. It is evident from a close study of local conditions that the lowest possible limit of working costs under present conditions has just about been reached by some of the more enterprising operators. Wood is becoming more expensive each year as the available supply is diminished and it becomes necessary to go farther and

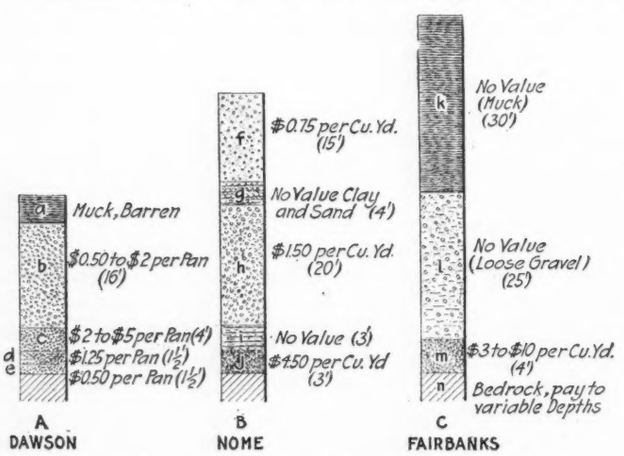


Fig. 5. Typical Vertical Sections of Placers

farther afield, the present cost being $15 per cord at many of the mines. Machinery cannot well be sold for much less than it is now, while provisions of all kinds have risen sharply in price during the past two years. The modification of some type of air drill for point driving bids fair to result in greater economy in the matter of thawing, but this innovation means an increased outlay for equipment and will not find immediate favor with many of the smaller operators.

One of the most unsatisfactory features at Fairbanks, from the standpoint of the operator, is the high rate of royalty demanded by the claim-owner. This varies from 10 to 30% of the gross output and is rarely under 15%. The same attitude has been carried over into lode mining, many leases on the most insignificant prospects calling for a royalty of 20 or 25%, and that is one reason why the industry has not progressed as satisfactorily as could be wished.

Promised Change through Railway Bill

The outlook at Fairbanks was gloomy until Congress passed the Alaska railway bill early in 1914, but there is now every reason to believe that the cost of mining will be greatly reduced as soon as the railway is placed in operation. It will be several years, however, before the benefits of the road are available, and meanwhile the output will undoubtedly show a further decrease.

The reduction of costs through the influence of the railway will come about in several ways. Living expenses will be less, partly because of lower freight rates and partly because it will no longer be necessary for the merchants to carry such large stocks to last them through the closed season. With the decreased cost of living and the greater ease of getting in and out of the district, wages should be much lower than the present figure, which is about $7.25 per day of 10 hr. for unskilled labor and more in proportion for skilled. Power costs should be cut to a fraction of the present figure. Even if a central electric plant is built it is doubtful if current will meet with an immediate large demand, but a great saving will undoubtedly be effected by substituting coal for wood as fuel for generating steam. Steam must be generated in any case to thaw the frozen ground in drift mining, and since the quantity required for this purpose is many times greater than that required for hoisting, it will be more satisfactory to use the steam hoist than to change to electric winding. For opencut mining and for pumping water for sluicing, however, the advantage may lie with electric power, but this will be influenced by other factors than actual power costs, since the operators are more familiar with steam power and place more confidence in it.

The railway is also expected to have an important influence upon capital seeking investment. Owing to the inaccessibility of the district it has been so expensive in the past to send in high-priced engineers to make even a preliminary report that capital has confined its attention largely to the coast of Alaska and the interior has been left to its own resources. It is to be hoped that the future will see an improvement in this respect.

[2]Five pans are usually assumed to be a cubic foot of gravel in place, though as high as seven pans to the cubic foot is used as the factor at Fairbanks, in which case a pan is equivalent to a heaping shovelful with a No. 2 round-pointed shovel.

Scandinavian Mining and Metallurgical Notes

Special Correspondence

In the recent Norwegian State budget the gross revenue from the Kongsberg silver mines is put at $192,500, which with interest of $48,610 on the drift fund gives a total income of $241,110. The working costs are placed at $201,805, including $2775 for a side line to the new railway station at Saggraenden. The manager says that the whole of the new development and construction work for which appropriations have been made during recent years will be completed in the autumn of 1915, when the whole of the mines will be regularly operated for an annual output of about 11,000 kg. For the last five years the average output was about 8230 kg., and for the prior five years about 7188 kg. The value of the silver is reckoned at 62 kroner per kg. The department points out that the rate of payment for silver used in the expired portion of the budget period had been lower than at any time for many years. Shortly after the outbreak of the war it went up, but had since steadily fallen, and was now between 22d. and 23d. per standard ounce. The budget figure at the par rate of the pound sterling is equivalent to a little over 59 kroner per kg., but at the present rate it is 63 per kg.

Fr. Kittelsen, of Stavanger, Norway, who recently

left for New York in the "Bergensfjord," is stated to have purchased a parcel of aluminum in America valued at $278,000. This purchase is attributed to the closing of the German market.

The total output of the Loekken pyrite mines, near Trondhjem, Norway, in 1913 was 124,182 tons of dressed and sorted ore. There was 129,660 tons shipped.

As regards the Meraker Smelteverk at Kopperaaen, in the province of Novdre Trondhjem, which has paid a dividend of 400% for two years in succession, it appears that the company was formed in 1906, and includes on the directorate A. E. Barton, chairman of the Alby company, Odda. The share capital is $13,750 in 50 shares of $275 per share, of which 49 are owned by the Alby company. The smeltery produces carbide, ferrochrome, ferromanganese-silicon and ferronickel.

Spitzbergen coal sells for 6.80 rubles per ton in Archangel, as against 15 rubles per ton for Newcastle coal in the same market. From this it may be gathered that Russian interests are very sanguine as to the future of their deposits on the island. An analysis of Spitzbergen coal gives the following results: Coke (free of ash), 64.58%; water, 1.55%; volatile, 33.89%; sulphur, 1.75%; and ash, 1.57%.

The Christiania "Aftenposten" remarks: "One hears so often about the copper famine in Germany, and that the government seizes copper kettles and similar houseware. In the meanwhile we have been told that in spite of the German prohibited copper exports there have, in the course of the last three months, been delivered to one Christiania firm alone goods weighing nearly 100 tons. We also know that a firm using copper as a raw material for its manufactures had in the middle of December a reserve of several thousand tons." The "Stockholms Blad" considers England's sulphur and pyrites embargo as being directed solely at the Swedish paper and pulp industry, as Germany can, unhindered, get her requirements by rail from Italy. The paper asks if it is England's intention to check Swedish industry to the advantage of Canada.

The Sulitjelma Pyrites & Copper Co., a Swedish company, has petitioned the Norwegian Government for permission to form a Norwegian company with the object of establishing, near the Christiania Fjord, before the end of 1915, a copper-extraction works to handle at least 30,000 tons of ores annually. It is proposed that Norwegian citizens shall have the first right of subscribing half the share capital. Director Holm Holmsen of the Sulitjelma Bolaget states that whereas there were originally only from 20 to 30 persons, there now dwell in the camp some 3500. The number of workmen is 1750, at an average daily wage of 5.04 kroner. Extensive development work and the establishment of the most modern plant are in hand, and he estimates that from 1916 the capacity of the works will have been increased by one-third, or corresponding to an output of 6000 tons of copper. Taxes during the last 20 years had increased abnormally. A sum of over 2,000,000 kroner had been paid in taxes, as against 2,880,000 kroner in profits, and the average profit for the whole period was only 2.953%. The share capital, formerly 3,000,000 kroner, was now 7,000,000 kroner. In wages the company had paid out 30,000,000 kroner, in commune tax 700,000 kroner, and in state taxes 500,000 kroner. Working conditions in this northern, sterile region were phenomenally severe. At times the snow lay 12 m. in depth, and ice formed on the lakes one meter thick. The present intention, however, is to keep up the traffic all the year round by means of a 600-hp. icebreaker. Of ore there was any amount, though it required a generation to establish an industry of that magnitude so far north. Things were looking bright, but new difficulties were being anticipated—namely, the labor question and the proposed factory-inspection laws, with curtailment of working hours. The mines and camp of Sulitjelma, it should be mentioned, are situated in Norway, close to the Swedish border.

The Norwegian government has prohibited the export of nickel, unwrought, except that produced by Norwegian works and accompanied with certificate of origin. The prohibit, which dates from Jan. 5, also includes nickel ores.

Ski Travel in California

By W. H. Wright*

It's a long, long way to that dear railway, was the unconscious paraphrase of a recent popular song that frequently recurred to me as I slipped and stumbled, with a 30-lb. pack, 16 miles through the snow from Butt Valley to the railroad at Belden, Calif. The only really unpleasant feature of the trip was the long time required to make it, 15 hours.

On the Belden Trail

I had been engaged in placer examination in Plumas County during the summer and it was desirable to work as long as possible. The weather had been exceptionally fine all fall, but it so happened that it was necessary to go to San Francisco just as the first storm of the season came, about the beginning of December. It was an unusually heavy storm for that time of the year. Roads were blocked over night and stage lines were put out of commission for a short time. Many people were caught without sufficient supplies for the winter. The heavy snows do not usually begin until after Christmas, but

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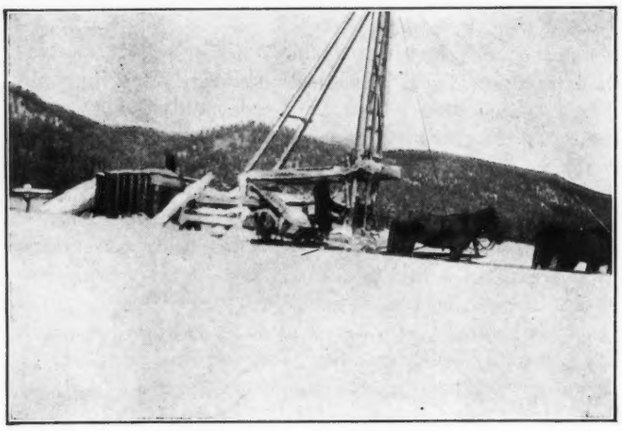
when they do begin it is almost impossible to move about the country except on snowshoes. The district is not densely enough populated for ordinary travel to keep even the main roads open, and many a stockman has had cattle perish by being snowbound, and many miners have had to go through the winter short of provisions, or move to where supplies could be had. The great difference between the snow of the Sierras and snow as it is generally known elsewhere is that the former is very wet and heavy, while at the same time one storm may bring a depth of several feet. Again, a cold spell usually comes after a storm and forms a thick crust that will sometimes support a man, but not a horse, and will cut a horse's legs to ribbons unless they are protected. I know of one instance where a stage, having brought in mail and passengers on the bare ground one evening, was unable to get out the next day and was forced to lay up for six weeks. Over night 4 ft. of snow had fallen.

SKI TRACKS IN THE FOREST RESERVES

More than 3 ft. of snow fell at Butt Valley on the first night of the storm, blocking the stage line to Keddie, so it was decided to go out by the way of Belden on skis. The first two miles of the road leads through a fine growth of timber up over a spur overlooking the north fork of Feather River at a height of 1200 ft. above it and at an altitude of about 4500 ft. It took four hours to accomplish this stretch, and it was done with great effort. The weather was warm enough to cause one's clothes to become saturated with perspiration while traveling, and at the same time one could not rest for any length of time without becoming chilled to the bone. As the snow was soft, causing the skis to sink, and the grade high, only about a hundred yards could be made between rests.

This piece of road passes through a part of the Forest Reserve containing some fine specimens of sugar pine, yellow pine, Douglas fir, cedar and the less valuable white fir. Some of these trees are 5 and 6 ft. in diameter and rise to a height of about 200 ft. The forest covered with newly fallen snow forms an attractive picture, portions of which the accompanying illustrations fairly reproduce.

Reaching the summit of the grade, two miles from Butt Valley, the trail then leads downhill to Caribou, a further distance of five miles; but several pitches of considerable length made traveling slow, and the soft, sticky snow would not permit coasting. At Caribou the amount of snow rapidly decreased, and from there to Belden, a distance of nine miles, the trail along the cliffs above the river was bare in spots, although the footing was very bad and progress was about half that which could be made on dry ground. The skis had been left behind at Caribou. The rapidity with which one may obtain a change of climate in California is illustrated by the fact that at Oroville, 60 miles by rail southwest from Belden and at 2100 ft. lower elevation, the harvest of the orange and olive crops was in full swing.



A KEYSTONE DRILL WORKING IN THE SNOW

Owing to the fine hospitality of the miners whose cabins are scattered along the river, the question of food caused no trouble.

Conclusiveness of Mining Patent

BY A. L. H. STREET*

The rule of law that where the validity of a patent covering a mining claim has not been impeached in a direct proceeding brought for that purpose it is conclusive evidence of the existence of a discovery vein in the claim, that the land was properly located, and that all preliminary and precedent acts necessary to authorize issuance of a patent have been performed in the manner required by law, including a requirement that the boundaries of the claim to be so marked on the ground as to embrace not exceeding 300 ft. on each side of the middle of the vein and not exceeding 1500 ft. in length along the vein, is recognized by the United States Circuit Court of Appeals for the Ninth Circuit, in the recent case of Stewart Mining Co. vs. Bourne, 218 *Federal Reporter* 327.

*Attorney, St. Paul, Minn.

Electromagnetic Ore Separation

By I. C. Clark*

SYNOPSIS—Electromagnetic ore separation depends upon differences in magnetic permeability. All known substances are either paramagnetic or diamagnetic, the great majority being diamagnetic. The chemical composition of minerals may occasionally serve as a guide to their magnetic properties. Many types of magnetic separators are in use, most of them using electromagnets. The type of separator to be used in any particular case depends upon the class of minerals treated. The separation of magnetite from gangue material and impurities is the most extensive branch of the process, and forms an important industry in the Eastern part of the United States and in several European countries.

Electromagnetic ore separation depends upon the principles of electromagnetism and the magnetic properties of minerals. All known substances are either attracted or repelled by a magnet. This attraction or repulsion depends upon the substance itself, the surrounding medium, the intensity of the magnetic field and the time the substance is subjected to it. The atmosphere has a definite magnetic permeability, and since it is the most common of all media, its permeability is assumed to be unity. The relative permeabilities of all other substances are determined by comparison with air. The great majority of substances are diamagnetics, though their magnetic repulsion is much less than the attraction of paramagnetics. Bismuth, the most diamagnetic substance known, has a permeability of —0.9998, while the permeability of iron may be more than 2000. The principal metals, divided into paramagnetics and diamagnetics, are as follows:

Paramagnetics—Iron, nickel, cobalt, manganese, chromium, cerium, titanium, palladium, platinum, osmium and certain alloys of the metals manganese, aluminum and copper.

Diamagnetics—Bismuth, antimony, zinc, tin, cadmium, mercury, lead, silver, copper, gold, sulphur, arsenic, uranium, rhodium, iridium and tungsten.

The magnetic properties of a metal vary considerably with the thermal treatment it has received. However, most metals may be heated to a temperature of several hundred degrees Centigrade (iron 680°) without greatly affecting their magnetic properties.

Action of Magnetic Flux

In a magnetic circuit all lines of force will follow the path of least resistance. In other words, the magnetic flux will pass through the most permeable substance at hand. Thus the magnetic lines of force are concentrated through paramagnetic substances and separated by diamagnetic substances. When paramagnetics are acted upon by a magnetic flux, they tend to align themselves in a direction parallel to the lines of force. The concentration of magnetic lines of force through paramagnetics induces magnetic polarity in them, causing the particles to arrange themselves in little bunches, north pole to south pole, etc. This is a common phenomenon in the magnetic separation of finely crushed minerals, such as pyrrhotite from blende.

Magnetic Properties of Minerals

Nearly all minerals are paramagnetic, but only a limited number are sufficiently so for commercial purposes. Paramagnetics are divided into strongly magnetic or ferromagnetic minerals and feebly magnetic minerals. The ferromagnetic minerals are magnetite, pyrrhotite, ilmenite, chromite, and franklinite; most remaining minerals are feebly magnetic. As yet no satisfactory method has been found to determine the specific magnetic permeabilities of minerals. The same mineral from different localities varies greatly in its magnetic properties, and no numerical factor could be of general use. The relative permeabilities of minerals can only be obtained by exhaustive tests under the influence of a magnetic field. Results from a large number of tests should be compared before any deductions are made. One or two tests might be inaccurately performed and misleading results obtained.

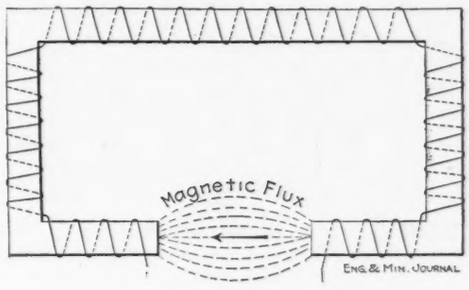


Fig. 1. Diagram of Magnet

The chemical composition of a mineral by no means determines its magnetic properties, though in some cases it may serve as a guide to them. Nearly all minerals separated by magnetic attraction receive their permeabilities from greater or less amounts of combined iron. Some ferrous minerals are sufficiently paramagnetic for such a separation, but their number is small. Oxygen is paramagnetic, while sulphur is diamagnetic. The metallic oxides are, therefore, more apt to be magnetic than their corresponding sulphides. Oxides are also more magnetic than carbonates. Iron pyrite contains nearly 47% metallic iron, the most magnetic of all known substances, and yet no magnetic field of sufficient intensity has ever been produced which will commercially attract this mineral. On the other hand, the bromide of copper, composed of two diamagnetic substances, is decidedly paramagnetic. Nonmagnetic sulphides and carbonates are frequently converted into magnetic oxides by roasting. In the examination of minerals for magnetic properties, test should be made both before and after either an oxidizing or a reducing roast, and the results compared. Blende containing small amounts of combined iron is slightly magnetic and has been separated from marcasite and pyrite by direct magnetization. However, in most cases an oxidizing roast would materially aid in

*Mining engineer, Midvale, Utah.

the magnetic separation of such minerals. Pyrite would thus be converted into the strongly magnetic oxide (Fe_3O_4) or sulphide (Fe_7S_8), and be much more susceptible to the magnetic field than the feebly magnetic blende or blackjack.

Electromagnetic Separators

The electromagnetic process employs a large variety of separators, differing widely in principle and in mechanical construction, each type being adapted for certain classes of work.

Two types of magnets have been used in magnetic separators; permanent and electromagnets. The first type has such a limited field of application in commercial magnetic ore separation that it is practically negligible. Electromagnets in the main consist of a soft iron or steel core, wound with one or more layers of fine, insulated, copper wire, through which an electric current is passed. Such a magnet is illustrated here diagrammatically.

Electromagnets all have north and south poles which may be interchanged by reversing the direction of the flow of current. A direct current is invariably used to excite an electromagnetic field. Electromagnets vary in strength according to the size of the magnet and the number of ampere-turns in the magnetic coil. The ampere-turns are obtained by multiplying the amperes of current passing through the magnetic coil by the number of turns the coil makes about the core. The size of the magnet and the number of turns remaining constant, the intensity of the magnetic field varies with the strength of the exciting current. Electromagnetic separators may have their magnetic poles which perform the separation directly energized by the exciting coils themselves, or energized by induction from the primary poles in whose magnetic field they lie.

In order to accomplish their work satisfactorily electromagnetic separators must fulfill the following conditions:

(1) The mixture of feed minerals must be properly presented to the magnetic field. (2) The magnetic particles in these minerals must be attracted by a uniform magnetic field of the proper strength. (3) The magnetic particles thus attracted must be removed from the magnetic field and promptly discharged from the separator. (4) The remaining nonmagnetic particles must be promptly discharged from the separator.

Attraction of Minerals

Much importance is attached to the manner of presenting the mineral particles to the magnetic field. Theoretically they should be only one layer deep when subjected to the field action. This will insure the minimum amount of mechanical entrainment during the attraction of the magnetic particles, leaving all the nonmagnetic particles behind. If the layer of feed minerals presented to the machine were several particles deep, the attraction of the magnetic particles (especially in an intense field) might cause considerable amounts of the nonmagnetic minerals to be carried away with them. Some magnetic particles might also remain behind, buried beneath nonmagnetic particles. A one-particle layer of feed minerals is practically never feasible, but the layer must be sufficiently thin that the minimum mechanical entrainment of nonmagnetic particles with the maximum mechanical efficiency will result. The proper thickness of the feed layer as well as the amount of sizing required can only be satisfactorily determined by experience. The separation of magnetite, perhaps, offers a single exception to this rule. Such material is in some cases fed directly to the first separation step from a 2-in. crusher, undergoing no sizing whatever. These ores can be handled in this manner only because magnetite has a high magnetic permeability and is not always intimately mixed with the gangue material. The magnetite generally occurs in the gangue in lumps, and fine crushing is not necessary for its separation. Intimately combined minerals will require fine crushing and frequently careful sizing before magnetic separation. A thin feed-layer is also required in the treatment of such minerals. In the separation of unsized material the same effect of mechanical entrainment is noticed as with a thick feed layer.

Feeding Devices

Several methods are employed in presenting the feed minerals to the magnetic field, four of which are as follows:

The ore, fed vertically on the machine, is carried through by specific gravity and subjected to the action of one or more electromagnets during its downward course. The Edison bar-magnet machine is a good example of this class, somewhat resembling the Huff electrostatic separator. The Mechernich separator also falls under this subdivision.

The ore, spread in a thin, uniform layer over the surface of a traveling belt or shaking table, is subjected to an upward pull by the magnets during its progress through the separator. The Dings, the Wetherill Type E, and the Cleveland-Knowles are examples of this type.

The ore, fed upon a revolving drum, is subjected to a magnetic field produced either by magnets within the drum or between which the drum revolves. Examples of this class are the International, Ball-Norton, Heberle, and some forms of the Gröndal separator.

The ore, spread over a conical, revolving table, is subjected to a magnetic field produced by magnets beneath all but a small section of the table. Air or water jets clear the table of nonmagnetic particles above the magnets while the magnetic particles are forced off at that sector having no magnetic attraction. The Froeding separator represents this type of machine.

Magnetic Field

The magnetic field to which the mineral particles are subjected, once being regulated, should be kept uniformly at the proper intensity. If too weak, considerable amounts of the magnetic minerals will pass off with the tailings product. If too strong, the intense action will cause some nonmagnetic particles to be mechanically carried over with the magnetic concentrates. If the magnetic field fluctuates in intensity, both products will vary with the strength of the field, a poor separation resulting.

Removal of Products

All products from magnetic separators should be removed as simply and expeditiously as possible. Many devices are used to remove the magnetic particles from the magnetic field. Scrapers and brushes are employed to scrape them from the magnets and centrifugal force is used in the cylindrical-type machines. A change of magnetic polarity, jets of water, or an air blast are also effective means of accomplishing this purpose. The nonmag-

netic minerals may pass through the machines by gravity and fall into bins placed beneath. They are also discharged at the end of a shaking table or traveling belt, or forced from the machine by means of air or water jets.

A large number of separators are on the market, but a wise choice will be made between a dozen or so standard makes. Obviously a very different type of machine is required to separate coarsely crushed magnetite from a gneiss gangue than finely ground blackjack from pyrite. In the first case a machine of rugged construction and low intensity field is required; in the second case a more delicately constructed machine with high-intensity field will be necessary. Before erecting a plant or purchasing the machines, tests should be made on the ore with several suitable types of separators.

Minerals Amenable to Magnetic Separation

The process of electromagnetic separation is adapted to numerous types of minerals. The most important application of the process is, perhaps, the separation of mag-

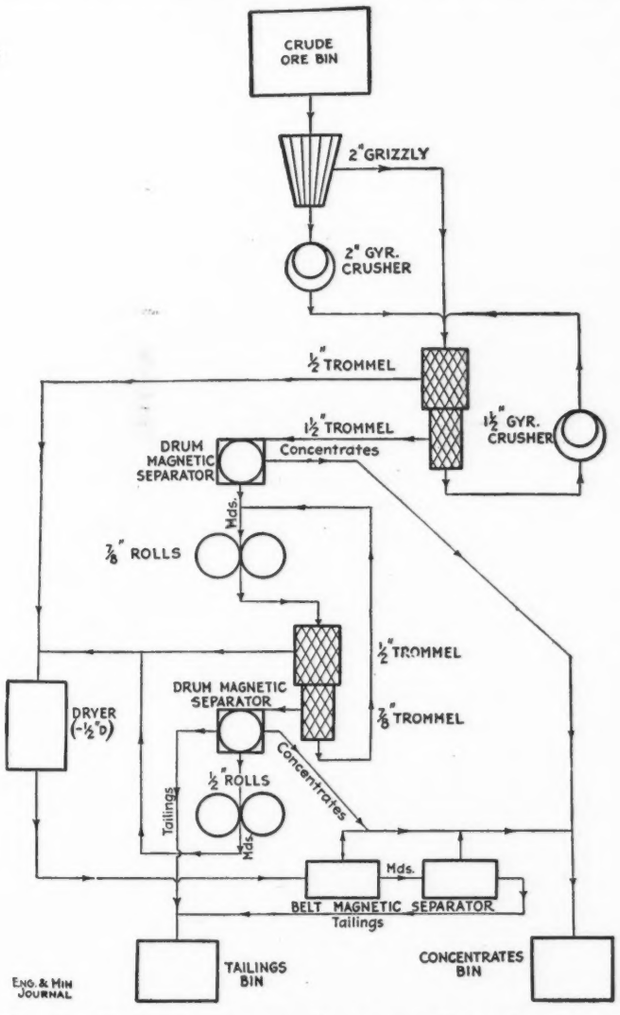


Fig. 2. Electromagnetic Separator Flow Sheet for Magnetic Ores

netite from gangue minerals, with the separation of roasted pyrite and siderite from blende a close second. A partial list of other applications of the electro-magnetic process is as follows:

The separation of roasted chalcopyrite from garnet and epidote; pyrrhotite and roasted chalcopyrite from a quartz- and mica-schist gangue; roasted copper, iron and nickel sulphides; roasted chalcopyrite from blende; pyrrhotite and magnetite from galena; argentiferous pyrrhotite from garnet and quartz; roasted limonite from smithsonite and calamine; pyrolusite from quartz gangue; franklinite, fowlerite, tephroite, and garnet from willemite, zincite, quartz, mica and calcite (Franklin Furnace, N. J.); roasted wolframite from cassiterite; monazite from silicious gangue; leucite from lava; magnetite from corundum; magnetite, menaccanite, chromite, and pyrrhotite from diamond bearing concentrates; magnetic galena (probably iron bearing) from zinc ore and gangue; blackjack from pyrite; hematite from gangue minerals and others.

Magnetite, with a specific gravity of slightly more than five, has been successfully concentrated from its ores by specific-gravity methods. But a large number of these iron ores contain impurities which materially decrease their value for use in the blast furnaces. The chief impurities are apatite ($3\ Ca_3P_2O_5 + CaCl_2$), pyrite (FeS_2), pyrrhotite (Fe_7S_8), and menaccanite or ilmenite ($(FeTi)_2O_3$). Specific-gravity methods are of little value in the separation of magnetite from these minerals, on account of their similarities in this property. Electromagnetic separators are almost universally used when treating a magnetite ore containing such impurities.

Several methods have been used in the electromagnetic separation of magnetite ores. In this country the principal magnetite deposits worked at present are in New York and New Jersey. Here the ore is rather coarse-grained and the magnetite crystals are not usually intimately associated with the gangue. These ores are, therefore, adapted to electromagnetic separation with very little fine grinding. In Sweden, however, the minerals composing many of the magnetite ores are in much finer state of subdivision. Finer grinding is required in the separation of them, the magnetic concentrates being dried and briquetted in preparation for the blast furnace.

Mineville District, N. Y.

Some of the largest magnetic mills in the world are in the Mineville district, N. Y. Several classes of ores are treated, varying in iron content from 35 to 69%, and in phosphorous up to 3%. Some of the crude ore is of shipping grade, but most of it is treated in one of the magnetic separating mills. The ores contain granular masses of magnetite, which is of Bessemer grade in the Barton Hill orebody, but high in phosphorous in the Old Red series. The lean ores are mixed with minerals from the wall rock, chiefly the basic syenite. Where the magnetite occurs in coarse crystals or lumps free from impurities it is treated directly by cobbing. But where the magnetite and apatite crystals are small and intimately associated, fine crushing is necessary before separation. Concentrates from the cobbing machines contain about 65% metallic iron. Tailings from these machines are dried, recrushed and run over a second series of magnetic separators. The tailings from these last machines are reground and retreated on finisher machines. The final concentrates average considerably more than 60% iron and the final tailings are relatively high in phosphorous. There is often sufficient phosphorous, in the form of apatite, in the tailings to be chemically treated, converting the phosphorous

into a soluble form which is extensively used as a fertilizer.

Mount Hope, N. J.

These are rich magnetite deposits in the Mine Hill belt near Wharton, N. J. Much ore of high shipping grade has been taken from these mines, but at present most of it requires concentration before shipment. At Mount Hope a magnetite plant capable of treating 600 tons of crude ore daily has been in successful operation for a number of years. The mill heads average about 35% iron, with considerable amounts of phosphorous and titanium. The gangue is a gneiss rock consisting chiefly of quartz, orthoclase, albite and anorthite. The shrinkage system of mining is practiced, and considerable wall rock is mixed with the ore in the stopes. The ore is crushed and sized, the large size being run through a cobbing machine which makes concentrates and tailings. The tailings are retreated over a second Ball-Norton drum separator, which makes final tails and concentrates. The small size from the first trommels is dried and concentrated on Ball-Norton belt separators. About half of the final products is tails and half concentrated magnetite. The concentrates averaged over 60% metallic iron, with some titanium and phosphorous as impurities. The tailings consist of sized, crushed rock, and are utilized for concrete construction work, top dressing for the state highways, and as filler for drawn stopes.

Separation of Magnetite from Impurities

When pyrite occurs as an impurity in magnetite a clean magnetic separation can generally be made. No magnetic field of commercial intensity has yet been produced which will appreciably attract pyrite; magnetite, on the other hand, is readily attracted by even a weak magnetic field. Pyrrhotite is a ferromagnetic mineral, and difficulty has been experienced in separating it from magnetite. A partial magnetic separation of these minerals has been attempted, but the results are generally unsatisfactory. The best practice in most cases is to pull off both magnetite and pyrrhotite as magnetic concentrates, which are then given an oxidizing roast to eliminate their sulphur contents. Experiments have been made on the magnetic separation of magnetite from ilmenite, but so far they have been largely unsuccessful. Since ilmenite is somewhat less magnetic than magnetite, a fractional separation of the two minerals can be made, but only at the expense of high iron loss in the tailings.

When magnetite and apatite crystals are intimately associated the ore must be finely ground before separation. Large deposits of such ores are found in some parts of Sweden. Apatite is an exceedingly brittle mineral which crushes easily to a fine powder, forming a coating over the magnetite crystals. Considerable amounts of phosphorous may be carried over into the magnetite concentrates in this manner. These concentrates should be cleaned by blowing this dust with an air blast or washing with jets of water. Such ores are usually ground so that 80 or 90% will pass through a 1/8-in. opening. The concentration is carried on entirely under water, magnetic slime separators being used. By this procedure the concentrates are washed free from the powdered apatite and no dust is given off into the surrounding atmosphere. The concentrates are dried and briquetted before shipment to the blast furnaces.

A typical flow sheet of a magnetic concentration, treating magnetite ore with gneiss gangue, is represented by Fig. 2. These flow sheets vary considerably with each type of ore treated, but the general principles of separation always remain the same.

Separation of Blende from Pyrite

The magnetic separation of zinc blende from iron pyrite is, perhaps, second in importance to the separation of magnetite from its impurities. This process has found extensive application in Missouri, Wisconsin, Colorado, Utah, British Columbia, and in several European countries. Ores containing blende or blackjack and pyrite free from gangue minerals have been separated directly by this method. Ores containing galena, blende and pyrite, together with gangue minerals, are also adapted for electromagnetic separation. In the latter case electro-magnetic separators usually follow wet concentration where galena-pyrite concentrates, blende-pyrite middlings, and tailings are made. Here the pyrite acts as a separating medium between the galena and blende, possessing an intermediate specific gravity. Galena has a specific gravity of 7.5, pyrite of 5.0 and blende of 4.0. A clean separation can be made between galena and blende, particularly in the presence of pyrite. The slight difference in specific gravities between pyrite and blende makes their separation practically impossible by ordinary wet methods. Consequently these blende-pyrite middlings are generally re-treated by some other method whereby commercial products may be obtained. Pyrite free from zinc, when it contains gold and silver, is readily salable to the lead smelter. A severe penalty is imposed upon pyrite containing more than 5 or 10% zinc, so freedom from this metal is essential. Blende containing little or no iron is also demanded by the zinc smelter. The iron content in blende above 5 or 10% is heavily penalized, so that only small amounts can be present to bring a good price. In some ores the gold and silver values lie chiefly with the pyrite, and the zinc smelter pays little or nothing for these metals. The saving in precious metals alone in such ores might easily pay for the cost of electromagnetic separation. When the minerals are pre-roasted to make the pyrite magnetic, the 15 or 20% sulphur reduction in the pyrite greatly increases its value to the lead smelter.

Electromagnetic vs. Electrostatic Separation

In the separation of blende-pyrite middlings the electromagnetic process has a close competitor in the electrostatic process. The method of treatment which will give better results in the long run can only be determined by exhaustive tests on a commercial scale. When the ore contains considerable amounts of gold and silver, their behavior alone may decide the question. That process which recovers the large percentage of gold and silver with the pyrite will be the one best adapted to such an ore. In many ores other considerations far outweigh the importance of gold and silver value. The Wisconsin and Missouri zinc ores usually carry less than 0.5% of combined iron in the blende. On the other hand, Colorado and Utah blendes may have as much as 15% of iron chemically combined with them. Such iron-bearing blendes are commonly known as blackjack, and are both slightly magnetic and fair conductors of electricity. When blackjack is to be separated from pyrite, both the electromagnetic and electrostatic processes present considerable diffi-

culties. In either case the pyrite product will contain large amounts of combined zinc, and the blende product will contain large amounts of combined iron. There may be as much as 15% zinc in the pyrite product and 10% iron in the blende product. These impurities in both products are due primarily to the chemical combinations of zinc and iron sulphides which no degree of fine grinding will free. The metallurgical treatment of such ores is a delicate process, and considerable experience is necessary to secure a good separation. Extensive tests with both the electromagnetic and electrostatic processes should be made before the final adoption of either. One process may work admirably on some ores where the other is a failure, and *vice versa*.

Separation of Magnetic Blackjack from Pyrite

Blende containing small amounts of combined iron is slightly magnetic and has been separated from raw pyrite as a magnetic product. This process was tried out at

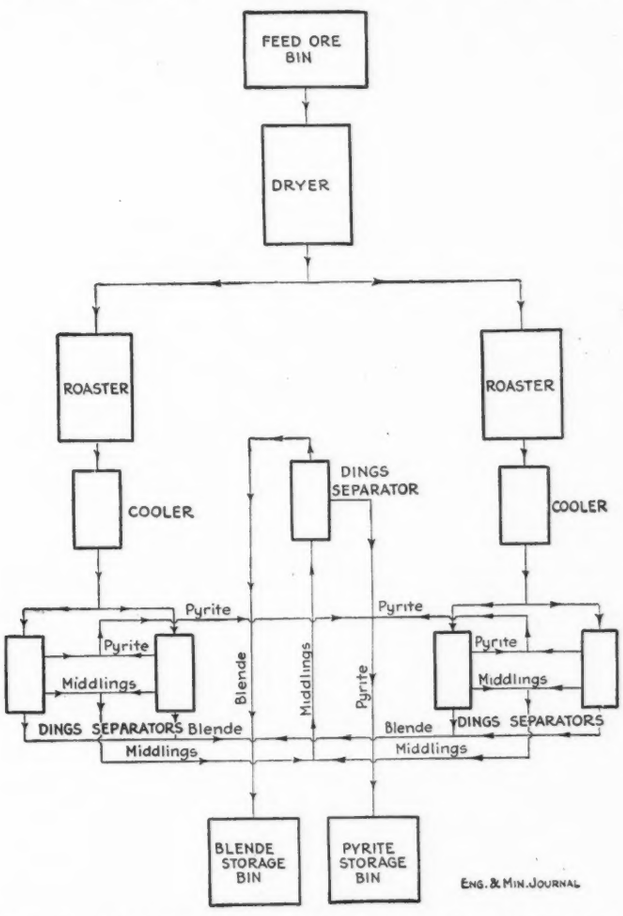


Fig. 3. Electromagnetic Separator Flow Sheet for Blende-Pyrite Middlings

Leadville, Colo., where the International separator was used. Preliminary tests on certain ores gave excellent results, and for a time the process was operated successfully on an extensive scale. But the ore supply was suddenly exhausted and the custom ores milled had a different mineralogical composition. The blende refused to be readily attracted even by an intense magnetic field, and neither the blende nor the pyrite products were satisfactory. Repairs to the separators themselves were both numerous and expensive. The teeth on the rotor soon wore smooth, thus decreasing the concentration of the magnetic flux. The brass guide plates separating the various products were also soon worn out and were expensive to replace. Experiments were soon instituted on a process which roasted the ore and separated the pyrite as a magnetic product on Cleveland-Knowles separators. This process was finally adopted and remained in successful operation for a number of years.

Roasting Pyrite for Magnetism

Roasting pyrite for magnetism is practiced in many localities, both in this country and abroad. The types of roasters used include shaft furnaces, hearth furnaces, and revolving cylindrical furnaces. The last named roaster has probably given the best results and been used in more localities than either of the others. All roasters should be constructed so that the amount of air in contact with the roasting minerals can be carefully controlled. The White-Howell furnace is a typical example of the cylindrical roaster and has been widely used in the process. These roasters have either a stationary or movable firebox at one end, and both coal and oil have been used for fuel. More external heat is required to start the roast than is necessary after the roaster has been running for some time. After the sulphur in the pyrite has once been ignited this reaction alone may furnish enough heat to carry on the operation. One firebox may be mounted on movable trucks and used to start several roasters in succession. After ignition the burning sulphur will give off sufficient heat to continue the process indefinitely. The air supply is obtained either by natural or forced draft, and is constantly under the control of the fireman.

The two strongly magnetic iron minerals are magnetite (Fe_3O_4) and pyrrhotite (FeS). These minerals are found in nature and may be made by artificial means. In roasting pyrite for magnetism one or the other of them (or both) is formed. Sulphur is first driven off at 370° C., but not until 450° is reached does all the pyrite become thoroughly magnetic. The ignition temperature of blende is 600° C. If the heat is carried much above that point some of the zinc will be oxidized to ZnO and lost by volatilization. The roast is generally carried on at a temperature just below the ignition point of blende. This insures the complete conversion of pyrite into either the magnetic oxide or sulphide. In most cases the minerals should be crushed to 10- or 20-mesh size before roasting and sometimes sizing is also necessary. If considerable difference in the size of the mineral particles exists, fine particles will be over-roasted to the nonmagnetic oxide (Fe_2O_3), before the coarse particles are completely converted into the magnetic sulphide. Usually a feed ground to 20-mesh can be successfully roasted and separated magnetically with no further sizing. Roasting for magnetism is an important and delicate operation and must be carefully performed to insure good work by the separators later. All magnetic particles of the roasted product should possess uniform magnetic permeabilities, so far as is practicable. Under-roasting will convert the fine particles into magnetic sulphide, leaving the coarse particles with only their surfaces partially oxidized. Over-roasting will convert the coarse particles into the magnetic oxide but burn the fine particles to the nonmagnetic oxide. Proper roasting should convert the fine particles into the magnetic oxide and coarse particles into the magnetic sulphide with a layer of magnetite on the surface.

The proper roasting temperature is only obtained by making numerous tests on the ore. Once determined, however, no difficulty should be experienced in keeping the roast constantly at the correct temperature. The roasted minerals may be subjected to a reducing atmosphere immediately before leaving the furnace. This completely reduces any nonmagnetic oxide formed back into the black magnetic oxide.

Magnetite formed in nature is an exceedingly stable compound. It has never been known to oxidize further into hematite when exposed to atmospheric agencies at ordinary temperatures. Artificial magnetite, on the other hand, is comparatively unstable and readily oxidizes into hematite upon exposure to the air (especially in the presence of moisture) at ordinary temperatures. For this reason roasted pyrite should be cooled immediately upon leaving the furnace and run over the separators as promptly as possible. A tight steel drum revolving in a trough of running water makes a cheap and efficient cooler. This drum is fed directly from the roasters and discharges on a conveyor leading to the separators. If passed through the machines immediately after roasting the ore need not be cooled to atmospheric temperature. Tests have been made where the feed to Cleveland-Knowles machines was so hot that it blistered the conveyor belt. The resulting separation was fully as perfect as when the roasted minerals had been cooled to ordinary temperatures. The degree of cooling necessary and the amount of exposure the roasted minerals will stand before over-oxidation takes place depend entirely upon the character of the ore treated.

When blende-pyrite middlings are roasted it may be necessary to dry the feed before passing it through the roaster. Large quantities of SO_2 and SO_3 are formed by the rapid oxidation of sulphur in the furnace. In the presence of moisture sulphurous and sulphuric acids would be formed, both of which are powerful corrodents. These acids rapidly destroy any metal work with which they come in contact, but in the absence of moisture their corroding action is greatly diminished. If the moisture is expelled from the ore in the drier, where practically no oxidation takes place, the sulphur gases formed in the roaster will do little or no harm.

Flow sheets of electromagnetic mills separating roasted pyrite from blende differ widely from mills treating magnetite ores. When separating magnetite, some ores are treated as large as 2-in. size, while in blende-pyrite separation practically all the feed will pass a 10- to 20-mesh screen. Fig. 3 illustrates a typical flow sheet of a mill treating blende-pyrite middlings resulting from wet concentration. A middlings product may be made on the first separation and re-treated on middlings machines. This is not always necessary, and finished products are often made with only one pass through the separator. The electromagnetic machines best adapted for this separation are the Dings, Cleveland-Knowles, and the Wetherill.

Miscellaneous Separations

Many other minerals are suitable for electromagnetic separation, and a description of each branch of the process would require a large-size volume. Siderite ($FeCO_3$) is rendered strongly magnetic by calcination, and limonite ($2\ Fe_2O_3 + 3\ H_2O$) by roasting in a reducing atmosphere. Occasionally an ore whose appearance would seem to defy any sort of separation has been treated successfully by the electromagnetic process. One such ore consisted of a mixture of partly oxidized iron and zinc sulphides containing blende, pyrite, limonite, siderite, hematite, smithsonite, zincite, and their transition minerals. This appeared to be a pretty tough proposition for magnetic separation as none of the minerals could be separated directly. It was decided to roast the ore at a temperature slightly lower than that required for a raw blende-pyrite mixture. After cooling, the roasted minerals were passed over a Dings separator, and the magnetic and nonmagnetic products made were both of commercial grade. Evidently sufficient CO was given off during the roast to reduce all Fe_2O_3 present to the magnetic oxide. The pyrite was oxidized to the magnetic sulphide and siderite, and limonite was converted into the magnetic oxide, thus rendering practically all of the iron minerals magnetic. When siderite or limonite are roasted for magnetism it may be expedient to add a little powdered coke at the end of the roast to insure a reducing atmosphere and prevent the formation of the nonmagnetic oxide. The above-cited example illustrates the possibilities of electromagnetic separation on some peculiar ores. No doubt many other similar cases exist.

Iron and Steel in Sweden

According to the report of the Swedish Ironmasters' Association for 1914, the war resulted in a decrease in the export trade and consequently a considerable decrease in production. The abnormally dry weather and the lack of water for the works were contributory causes. The iron and steel works during the latter part of 1914 maintained production at about the level to which it was reduced by the outbreak of the war. During the period August-December there were from 63 to 66 blast furnaces in operation out of a total number of 124, and 110 to 134 Lancashire hearths out of 260. At the end of the year only 45 out of the existing 75 openhearth steel furnaces were operating, while of 24 bessemer converters only six were working.

The production figures for three years past were as follows, in metric tons:

	1912	1913	1914
Pig iron	699,800	730,300	635,100
Puddled (wrought) iron	148,800	158,500	113,300
Converter steel	107,300	115,800	93,000
Openhearth steel	404,100	469,400	407,600

During the winter months of 1914 an abundant supply of charcoal was available, though the imports of coal were obstructed and prices 50% higher on account of freight rates. The rise in coal prices was particularly felt, since the lack of water involved ironworks in a greater use of coal.

The exports showed a heavy decrease, most of which was due to the war. The foreign trade was as follows for two years past, in metric tons:

	1913	1914
Pig and scrap	194,100	167,400
Ferro and spiegel	21,400	12,200
Ingots, blooms, etc.	59,700	34,800
Wire rods	38,900	27,500
Iron bars	154,800	103,000
Other iron and steel	33,700	38,100
Totals	502,600	383,000

Of the total decrease, 84,000 tons was in the five months August-December. The exports of iron ore decreased in 1914 by 1,459,000 tons.

Some Results of B., A. & P. Railway Electrification*

SYNOPSIS—The electrification of the Butte, Anaconda & Pacific Ry. was described in the JOURNAL, *Mar. 14, 1914. After months of operation, remarkable results and costs were obtained. In operating expenses, average decrease of 36.19% secured over steam operation. Ton miles hauled increased 8.77%.*

The electrification of the Butte, Anaconda & Pacific Ry. was described in the JOURNAL, Mar. 14, 1914. Since that time, however, more interesting and complete data are available concerning the cost of electrical operation and the results as compared to the steam methods previously employed. Prior to the decision to electrify the railroad, the machinery at the mines and the smeltery had mostly been electrified, and the results had been so satisfactory that the railway company investigated the advantages that might be expected from the electrification of its lines. As a result the work was done under contract with the General Electric Co. In order to understand the costs and results obtained by the new system, however, it should be understood that probably a vital consideration leading to the electrification was the rapid development and physical consolidation of a network of hydro-electric power plants in the territory tributary to the railroad. A contract for power was made with the Great Falls Power Co., which, operating under the same management and in physical connection with the system of the Montana Power Co., was enabled to guarantee an ample supply of power at all times with exceptional freedom from interruptions to service and at a reasonably low price.

TABLE I

	No. of Trains	Meeting Points, Hr.	Meeting Points, Min.	Delays on Account of Engine and Power Failure, Hr.	Delays on Account of Engine and Power Failure, Min.	Lost Running Time, Hr.	Lost Running Time, Min.	Total Delays, All Cases, Hr.	Total Delays, All Cases, Min.
Steam, 1913	272	15	49	0	44	4	13	20	46
Electric, 1914	280	3	54	0	51	0	25	5	10
Decrease	8*	11	55	0	7*	3	48	15	36
Percentage of saving due to electrical operation	2.94%*	75.66%		15.91%*		90.10%		75.12%	

* Increase.

POWER

The Butte substation, with which the Anaconda substation is connected by three high-tension trunk lines, receives power over five separate transmission lines from six hydro-electric stations of the following rated capacities:

Big Hole development	3,000 kw.	60-ft. head
Madison River development	9,000 kw.	110-ft. head
Cannon Ferry development	7,500 kw.	35-ft. head
Hauser Lake development	14,000 kw.	60-ft. head
Black Eagle development	3,000 kw.	44-ft. head
Rainbow development	21,000 kw.	110-ft. head
Total	57,500 kw.	

In addition, there is now under construction the Great Falls development, with a capacity of 60,000 kw. and with a 155-ft. head. All of these plants are on the Missouri River watershed, and operate with a free interchange of power. The individual plants are also provided with storage reservoirs aggregating 125,000 acre-feet of total available storage capacity. All of these reservoirs operating under one control are capable of developing from stored water alone the equivalent of about 100,000 electrical horsepower for a period of 100 days.

The advantage of purchasing electric power from this large operating system, instead of developing the required power independently, was readily apparent in the case of the Butte, Anaconda & Pacific Ry. The road was relieved of all the first cost of development and transmission of power, and of all operating expense up to the point of delivery of power to the two substations. The cost of the delivered power is less than it would have been from an independent development, because the power company is enabled to operate large generating stations at a relatively high load factor, about 75%, whereas an independent plant purely for the operation of the railway would have to operate in this case at about 30% load factor, with correspondingly high fixed and operating charges per kilowatt-hour used. The large number of generating stations and the complete network of transmission lines already developed by the power company afford ample insurance against the interruption of the railroad service due to possible failure of any part of the generating or transmitting system of the power company. The enormous flywheel effect of the motor loads connected to the power system maintain extremely steady speed and voltage under the most extreme variations of load on the railroad. While these factors should be borne in mind when considering the results and comparative costs it is also interesting to observe that the operating records amply bear out these contentions.

Tabulated results from a comparison of the delays to the passenger trains for June, 1913, under steam operation, with the same month in 1914 under electrical operation, is shown in Table 1. While the month of June was selected at random, the results are considered representative of general performances. It will be observed that under electrical operation, 2.94% more trains were operated, with a decrease of 75.66% in time lost at meeting points; 45.45% decrease in time lost because of engine failures (offset by some stoppages due to power failure), and 90.10% decrease in lost running time, with a total decrease of 75.13% in delays of all kinds. A comparison of trains and tonnage during the same periods shows that with a slight increase in the total tons of ore hauled, the average tons per train was increased from 1761 to 2378, or 35%, thus decreasing the average number of trains per day from 12.5 to 9.3, or 25.6%. A comparison of the time per trip for these trains, covering the first three days of June in 1913 and 1914, respectively, is representative of the gain in this direction to be added to the decrease in the number of trains. The average time per

*Abstract of article by J. B. Cox, in "General Electric Review."

trip during steam operation was approximately 2 hr. 25 min., while with the electric locomotive it was approximately 1 hr. 45 min., showing a decrease of 40 min., or 27.5%. The distance in this case was 21.8 miles. As a consequence, the overtime in this service between Rocker and Anaconda was decreased 73.5% and the total time 42%, resulting not only in greater economy to the railway company, but in shorter and easier hours for the crews. The changes effected in the service on the Missoula Gulch line, running between Rocker and Butte Hill yards, is particularly striking. This line is 4.5 miles long with a ruling gradient of 2.5%. Under steam operation, two complete crews with locomotives of the Mastodon type had been required to handle the service, each averaging six trips per day. In their place, a single crew with a double-unit electric locomotive performed the work successfully. From 35 to 45 loaded ore cars are taken down from Butte Hill yard to Rocker and about an equal number of empties taken up. In addition to the empties, large quantities of timber and supplies for the mines are delivered over this line.

At the time this was the first installation of 2400-volt direct-current apparatus for the operation of a railway in this country, 1500 volts being the highest previously installed for such purposes. The results have been more satisfactory than anticipated, and the development charges, due to such imperfections as usually show up during the first year of operation, have been perhaps smaller than is customary with an undertaking of like magnitude, even where standard apparatus is used. After a mileage of from 25,000 to 50,000 each the motors of the locomotives without exception were found to be in excellent condition. Small change in the personnel of the maintenance or operating departments of the railway has been made on account of the electrification and there has been no reduction in salaries or wages. An extra man with electrical experience was placed in the shops to supervise the electrical repairs to the locomotives and three linemen were retained for the maintenance of the trolley system.

Costs

With approximately 20% of the total locomotive miles operated with five steam locomotives, it was found that the cost of the latter was about 40% of the total cost of all locomotive performance. Some of the savings that apparently result from the electric operation are remarkable. From comparative figures covering operations by steam from December, 1912, through May, 1913, and electricity from December, 1913, through May, 1914, the saving from the partial substitution of electric power for coal, for instance, was at the rate of $150,727 per year. This is still more remarkable when it is considered that more than 39% of the total combined costs for fuel and power for the period considered was for coal, and charged against electrical operation. In this instance, the saving in this one item alone would undoubtedly justify the expenditure covering the entire cost of electrification. It is to be noted (see Table 2) that with a single exception, that for depreciation of equipment, every item shows a substantial percentage of decrease in favor of electrical operation. One cause for the high showing under "maintenance of equipment" is the method of apportioning same on new equipment, made necessary by the rulings of the Interstate Commerce Commission.

TABLE II. PERCENTAGE OF SAVING, ACCOUNT OF ELECTRICAL OPERATION

Maintenance of Equipment Expenses	
Repairs	39.17
Depreciation	50.95*
Supervision	10.54
Total	26.05
Transportation Expenses	
Wages of enginemen	31.81
Enginehouse expenses	37.68
Fuel and power	47.81
Water	75.90
Lubrication	49.31
Other supplies	21.83
Total	43.62
Grand total	39.93

* Increase.

The total saving from locomotive performance alone was at the rate of $237,581 per year, to which should be added the credit of handling an increase of traffic at the rate of 13,938,136 ton-miles per year, or 8.77% more than was handled by the steam locomotives during the period compared. To this saving from locomotive performance should be added the saving from trainmen's wages which is at the rate of $31,146 per year, or a decrease of approximately 21%, due largely to the elimination of overtime, making the total saving from these two items $268,728 per year. Deducting $10,839 for maintenance of the distribution system leaves $257,889 as the net operating saving per year due to electrical operation.

The total cost of the electrification including a change of signal system on Smelter Hill, the extra motor-generator set recently installed at Anaconda, interest during construction and all incidentals due in any way to the electrification, was, in round numbers, $1,201,000. This does not include the step-down transformers, which are the property of the power company; but on the other hand no deduction was made for the salvage due to the elimination of 20 steam locomotives. By making the correction for the item of depreciation, the total saving per year from locomotive performance would be reduced to $221,991, making the total net saving $242,299, which is equivalent to 20.02% on the entire cost of electrification, to say nothing of the increased capacity of the lines, the improvement in the service and more regular working hours for the crews. If taken on the basis of the increase shown in net operating revenue or operating income, this percentage is slightly greater, the rate of increase per year for these items being $288,150 and $282,016 respectively. The estimate on which the decision to proceed with the electrification of the road was made, placed the annual net saving expected at 17.5% of the cost, so that the results financially have been quite as satisfactory as the general performance of the equipment.

TABLE III

Item of Operating Expense	Steam, 1913	Electric 1914	Decrease, 1914	Per Cent. Decrease
Fuel and power	$315,235.74	$164,508.70	$150,727.04	47.81
Repairs	124,787.90	92,278.08	32,509.82	26.05
Enginemen's wages	104,461.18	71,225.28	33,235.30	31.81
Enginehouse expenses	29,907.80	18,638.38	11,269.42	37.68
Water	4,953.66	1,193.70	3,759.96	75.90
Lubricants	9,751.44	4,942.32	4,809.12	49.30
Other supplies	5,823.52	4,552.36	1,271.16	21.83
Total locomotive performance	$594,921.24	$357,339.42	$237,581.82	39.93
Trainmen's wages	$147,632.30	$116,486.00	$31,146.30	21.10
Grand total	$742,553.54	$473,825.42	$268,728.12	36.19
Ton-miles hauled	158,917,720	172,855,856	13,938,136	8.77*

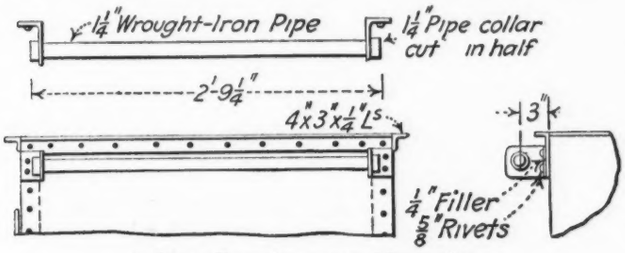
* Increase.

Details of Practical Mining

Safety Hand Grip for Mine Car

By H. H. Hodgkinson*

When ore is loaded from chutes and the cars are heaped up, the trammers often receive badly bruised hands due to the chunks on the top of the car striking another chute on the way to the dump, since the men persist in gripping the angle iron around the rim of the car body. Then, too, it is sometimes necessary to hold back the car, to stop it or prevent it going downgrade too fast and leaving the



A Pipe-Bar Grip for Mine Cars

track. There is no suitable place on the car for holding, and the angle-iron rim gives a poor grip.

The convenience here described consists of a piece of 1¼-in. wrought-iron pipe, 2 ft. 9¼ in. long, threaded at each end and attached to the car by means of two 4x3x¼-in. angle irons, which have each a 1⅝-in. hole bored to fit the outside of the pipe. These two angle irons are riveted fast to the body of the car in such a position as to bring the grip just under the angle iron, which would then act as a guard to the hands of the trammers. A 1¼-in. pipe collar is cut in half to take the place of a nut, half being put on each end of the pipe or grip.

*Mining engineer, Franklin Furnace, N. J.

Air Compressor or Steam Engine

An unusual air-compressor installation has been prepared by the Nordberg Manufacturing Co., Milwaukee, Wis., for the Canadian Mining & Finance Co., Timmins, Ont. It is a standard two-stage cross-compound machine having cylinders 22x37x31 in., with mechanically operated Corliss valves. The compressor is to be driven by a 25-cycle synchronous motor at 105 r.p.m. The unusual feature about the machine is that it is to be used as a steam engine in case of necessity, this being possible with the type of valve used.

The mining company operates its equipment—consisting of the mine hoist, compressors, underground pumps and concentrating mill—electrically, purchasing power from an outside source. To guard against a possible delay to operations due to any irregularity in the transmission service a steam reserve plant was considered necessary. Ordinarily a full equipment of boilers, engines and generators would be necessary, but with compressors of the type furnished only the boilers are to be installed. Steam may be turned into the high-pressure cylinder of the compressor, being delivered to the intermediate receiver and thence to the low-pressure cylinder as in any Corliss engine. The operation will, of course, be reversed, and the motor turning in the opposite direction will act as a generator. With a slight readjustment of the valves, the economy will be nearly as good as that of an engine designed for the work.

The quantity of steam is regulated by an angle-throttle valve in the discharge pipe of the compressor between the high-pressure cylinder and the receiver.

By this arrangement enough current can be generated to run the mine at reduced capacity until service from the usual source is resumed.

Safe Hand Tools*

Personal caution is the greatest safeguard; a spill from a 20-ton ladle of molten metal may cause a serious burn, and a chip struck from the battered head of a 20c. chisel may result in blindness to an employee. A defective weld in a crane chain may allow a load to "let go" with disastrous consequences, while the use of a weak, cross-grained or splintered sledge handle may let the sledge fly across the shop and injure workmen who may be in its path. Many injuries may also be traced to the use of loose-fitting wrenches, splintered or broken shovel handles and to other uncared-for hand tools.

The largest contributors to injuries in the latter class are chisels, punches, wedges, blacksmith's tools, stone-cutter's tools and similar small hand tools which are subjected to frequent hammer blows, in consequence of which their heads become readily "mushroomed." A mushroomed head presents a dangerous condition, for the next hammer blow may break off one of the slivers of steel hanging to the body of the tool and send it flying through the air, with great risk of injury to the man handling the tool or to others near by. The remedy costs little, is well known, simple and effective. When the head of such a tool is found to be chipped, cracked or mushroomed, it should be promptly laid aside and not used again until the head has been ground down or dressed to its proper shape. A good practice applicable to cold-chisels and other tools that must be sharpened frequently is to grind down their heads every time the tools are sharpened, thus preventing the development of a mushroomed condition, and at the same time retaining the hammer-hardened ends, which will not spread so rapidly in the future life of the tools. This practice also avoids much waste of the steel, which would have to be cut off if the heads of the tools were reforged. As a further precautionary measure, all steel hand tools that are likely to be struck by hand hammers or sledges should have the upper part of the shanks shaped round and slightly tapered from the top downward before they are used at all; care should also be taken to make such tools of the right grade of steel, else the bat-

*From N. F. A. "Safety Bulletin," Dec. 1, 1914.

tered, overhanging portions of the tools will readily break off.

The character of hammer and sledge handles and their method of fastening are worthy of more than passing notice. If not straight-grained or if the wood used is "short" in texture, it must be expected that such handles will quickly splinter and break; if attached in a slipshod manner, or if insecurely fitted, or if wedged by nails instead of wedges, or if water-soaked so as to swell and become only temporarily tight in the hammer head, it is obvious that they will become loose and that the hammer or sledges will fly off when the nails loosen or when the handle dries and shrinks. When it is recognized that the peculiar function of hammers and sledges is to strike blows with considerable force, it becomes clear that there is no economy in cheap, weak handles, and that all handles should be carefully purchased and properly fastened in place.

The use of defective file or screwdriver handles also contributes to the sum of injuries caused by hand tools. When such handles are split, the handle end of the file or screwdriver is liable to be forced through the handle and puncture the user's hands; when these tools are used without handles similar injuries sometimes result. The use of only the best handles is a safe as well as an economical measure.

When smooth-faced hammers or hatchets are used for driving nails, the nails frequently glance and strike persons who are working in the vicinity. This danger can be minimized by using hammers or hatchets with roughened faces.

Wrenches are wrongly used and are abused often because the management is over-economical, but usually because the employee is too lazy or too hurried to secure the right wrenches for the job. Solid wrenches that are too large for the nut or the bolt head are soon worn into a rounded shape that allows them to slip and bruise the workmen's hands, also spoiling the shape of the nut or the bolt head, which in turn presents an added risk of the same kind. Wrenches of the right size but worn beyond the possibility of giving safe and effective service cause similar injuries. Again the remedy is simple and even economical; the wrenches should be ground or milled to suit larger nuts, or if there is too little stock left, they should be scrapped. Monkey-wrenches or Stillson wrenches with bent jaws or worn adjusting parts are also likely to cause injury by slipping; such wrenches should be repaired or replaced. Wrenches are cheap; when in good condition they are not only safest, but they do more and better work than the faulty variety.

Another tool in common use which has contributed a large quota of accidental injuries is the pinch bar used to pry heavy bodies short distances or to "pinch" railroad cars or industrial cars to a new position on their tracks. These tools are bound to slip occasionally and bruise or crush the users' hands. A disk with a hole through it slipped over the bar would protect the workmen's hands from injury. This safety device also lends confidence to the user and thus promotes more rapid work.

Some effective system should be adopted and carefully followed in each shop to prevent the use of improper or defective handles or tools. Only such handles and tools should be purchased or put into service as are safest and best for the purpose. Even these may in time become unsafe by wear; it therefore becomes imperative that they should be inspected regularly and their safe condition maintained. In shops where such tools are turned into the toolroom or stockroom every night, the storekeepers can be instructed to issue again only such tools as are safely fit for service. Where such tools are kept out for longer periods, the foreman or subforeman in small shops, or a regularly appointed inspector in large plants, should see to it that defective tools are turned in promptly for renewal or repairs. In some plants the foreman or inspector condemns such unsafe tools by wiring a red tag to them, indicating that they must not be used again until they have been put in good condition.

Furthermore, the danger of using defective tools must be impressed upon the workmen from day to day by friendly counsel, stern reproof, and in some cases by severe discipline. The matter will not take care of itself.

Collapsible Geological Model

The E. J. Longyear Co. in its exploration work has occasion to draw geological maps. W. J. Mead, geologist for the company, has developed the typical geological map

FIG. 1. RIGID, TRANSPARENT MODEL OF CELLULOID

until it is really a collapsible model. The idea of a geological model is not, of course, new. Various kinds have been in use for years. A type of rigid transparent model made of celluloid strips is shown in Fig. 1. The top of this model represents the surface of the property, and contains the drill-hole cross-section lines, property lines, etc. The square, vertical partitions represent vertical sections through each line of holes, and the data from each hole are shown on them. By properly

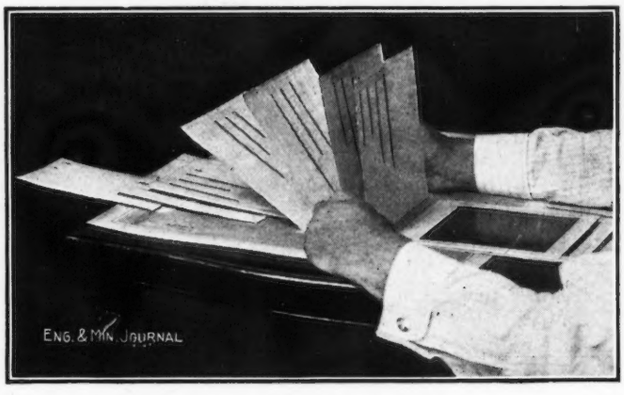


FIG. 2. THE COLLAPSIBLE MODEL IN USE

marking or coloring any given formation in each section, a graphic representation of the exploration is obtained. In the case of this celluloid model, some trouble was experienced with warping.

Mr. Mead's collapsible model has many of the advantages of the celluloid and has not the disadvantages of bulkiness or possible warping. Fig. 2 shows such a

model in use, its manner of operation being apparent. The sections through the holes are made on squares of cardboard, hinged by canvas strips to a common base. Various geological formations and other features can be shown in colors, and the relation of one hole to another is quickly observed by holding up any number of the leaves. When flattened out, the whole can be closed up like a book the covers of which are stiff bristol board.

Storage-Battery Locomotives

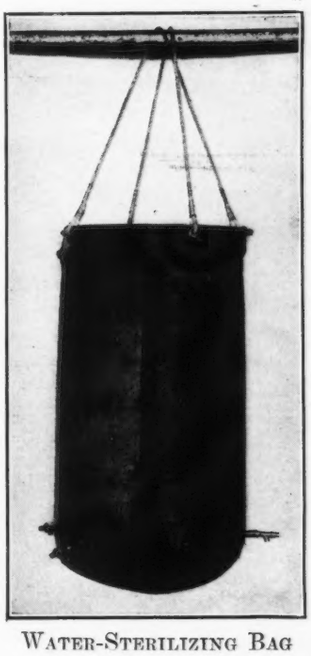
In the discussion of J. W. Gwinn's paper on "Underground Haulage by Storage-Battery Locomotives in the Bunker Hill & Sullivan Mines," at the annual meeting of the American Institute of Mining Engineers, Girard B. Rosenblatt pointed out that the efficiency of the storage-battery locomotive declined rapidly when too great a drain was made upon its power, comparing the effect with that on a small steam boiler on which large sudden demands were made for steam, with resulting reduction in steam pressure. Hence he cautioned the user against buying too small a battery for a locomotive, and also against specifying too large a motor, because the motorman would invariably use the motor at maximum capacity when he had an opportunity. Successful surface locomotives were not necessarily well suited to underground service, and the underground storage-battery locomotive should therefore be designed for that purpose and not copied from a successful surface locomotive. He said that the storage-battery locomotive had evidently proved satisfactory at the Bunker Hill & Sullivan properties, since associated properties under the same management, Alaska Treadwell and Alaska-Juneau, were also installing this type of locomotive for underground work.

He also called attention to the fact that the storage-battery locomotive is best suited for short hauls, its power efficiency not being so good as that of the trolley locomotive, which is best adapted to long hauls and heavy loads. John Langton developed the latter idea further and reduced Mr. Gwinn's figures of power consumption to the ton-mile basis. He computed that the power consumption of the storage-battery locomotives at Bunker Hill & Sullivan mines was 1.785 kw.-hr. per ton-mile. At Bisbee, Ariz., Charles Legrand had previously reported a power consumption for storage-battery locomotives of 1.6 kw.-hr. per ton-mile, which might be considered in fairly close agreement with the Bunker Hill & Sullivan results. These figures were about double the power consumption of trolley locomotives, but he nevertheless considered the storage-battery locomotive worth while for special purposes, as the power cost was so small a proportion of the total cost of the mining operation. The storage-battery locomotive had features of safety much superior to the trolley locomotive, and its convenience in operating close to the working face was likewise superior.

George R. Wood, of the Berwind-White company, told of two seven-ton storage-battery locomotives which his company was operating. These had probably the most severe duty of any such locomotives in the country, being largely engaged in hauling empties up a 14% grade. The motors had been set low so that any sparking would be at an extremely low point, and if explosive gases had reached as low as this in the working place, it was not likely that the miners would be there. About 7 hr. was required to charge the battery of one of these locomotives, and 1 hr. was devoted to "boosting." The cost of the locomotives was about twice that of equivalent trolley locomotives, not counting trolley wires and track bonds. These storage-battery locomotives cost approximately $4000 each, about one-half the cost being represented by the battery.

Water-Disinfecting Outfit for Field Use

A water-disinfecting outfit for field use, consisting of a canvas bag as a water-holder and canteen-filler and a carton of sealed glass tubes containing calcium hypochlorite, has been got up by Major William Lyster of the United States Army, according to *Engineering News*. The bag is of specially-woven flax canvas, 20-in. diameter and 28 in. long. At the top it is sewed to a flat galvanized-iron ring, hinged so as to fold in half. At the bottom are five self-closing nickel faucets, from each of which a canteen may be filled in ten seconds.



WATER-STERILIZING BAG AND CANTEEN-FILLER

The bag is to be used only in a stationary position, when it may be suspended by ropes, as shown by the view. When filled it weighs about 330 lb. When empty its weight is 7 to 7½ lb.; it may then be folded into a convenient package, ready for transportation.

The calcium hypochlorite used for disinfection is put up in ⅜x3-in. sealed glass tubes, 60 of which, weighing only 10 oz. altogether, are packed in a 7½x3½x4¼-in. corrugated paper carton. The tubes are marked with a file so as to be readily broken without splintering the glass. Each tube contains 14 to 16 grains of calcium hypochlorite, containing 30 to 32% effective chlorine, or just enough to treat one filling of the water bag at the rate of 1 to 500,000. Bacterial tests have shown that with this dosage 15 minutes of contact kills most of the amœbæ causing dysentery, and 30 minutes all of them, and that usually water so treated is safe to drink in 5 to 10 minutes. The use of a filter cloth placed over the mouth of the bag in filling is recommended, as the hypochlorite acts more readily on clear water than on that containing suspended matter.

Although designed primarily for army use, the equipment described would be just as serviceable for any other body of men on the move where lightness of baggage is important.

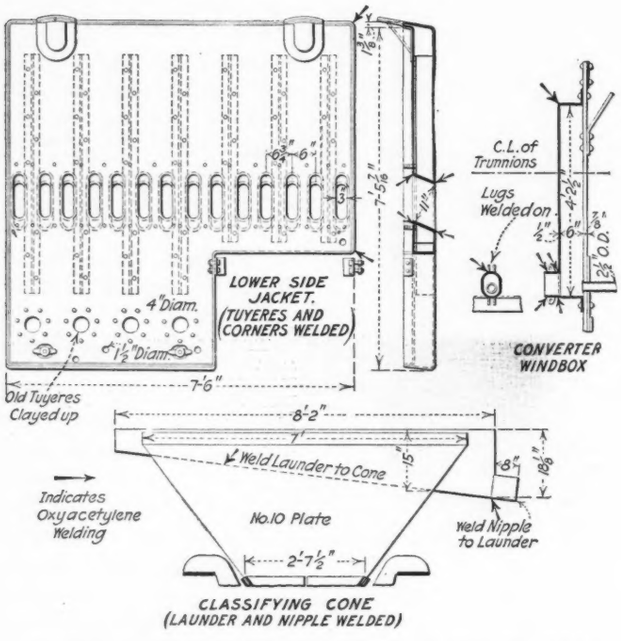
Mt. Hope Mine Model

In the article on the Mt. Hope mine model in the JOURNAL of Mar. 6 the author's name is given as J. C. Stockland, whereas it should have been J. C. Stoddard.

Details of Milling and Smelting

Oxyacetylene Welding at Great Falls, Mont.

Mention was made in the JOURNAL of Feb. 27, 1915, of the frequent use of oxyacetylene welding apparatus at the Boston & Montana works of the Anaconda Copper Mining Co. Some of the work is illustrated in the accompanying drawings. The company purchased in 1910 a Sanford portable welding machine, and during the last five years the mechanics at Great Falls have had an opportunity to become expert in the use of this apparatus, which is now frequently called into service both for repair and construction work.



SOME ACETYLENE-WELDING JOBS AT GREAT FALLS

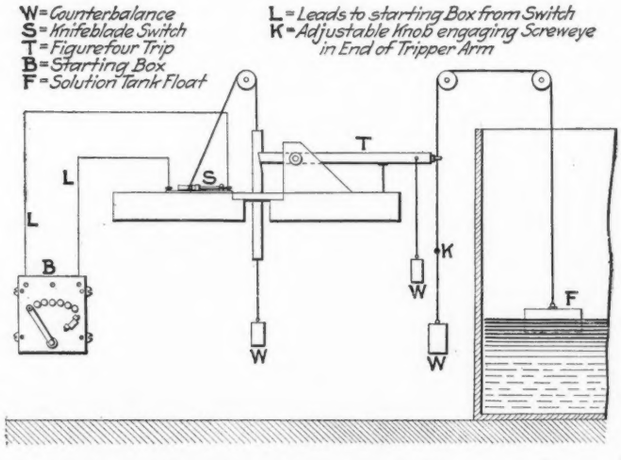
One of the accompanying drawings shows a blast-furnace water-jacket to which oxyacetylene welding and cutting were applied. The corners of this jacket are welded with the oxyacetylene apparatus, as are also the fourteen 3x11-in. tuyeres. These openings are burned out of the solid plate and then the tuyere sleeves, which have been previously welded, are placed in position, held by clamps and welded to both of the jacket sheets. The old method of flanging the corners was expensive, and it was also difficult to avoid thinning the metal at the corners. The new method of flanging the plates and welding the corners is much cheaper and better. Considerable welding is done on the windbox and tuyeres for the Great Falls 20-ft. vertical converters. The windbox shown in the accompanying drawing was built up of two 4x6-in. angle irons with a ½-in. plate welded on the front edge for a distance of about 22 ft. around the converter. The tuyere nozzle is usually made of 4-in. extra-heavy pipe welded to the above-mentioned ½-in. plate. On the nozzles are also welded four 3x⅜-in. lugs to receive the bolts that hold the tuyere valves in place.

The hydraulic-classifying cones used in the concentrator at Great Falls are also shown in the accompanying drawing. The seams of these cones are welded and the overflow launders around the outside are welded in a water-tight joint around the circumference. A nipple is also welded to the overflow launder, to make a suitable connection for carrying away the water. These devices are by no means all to which acetylene welding is applied at Great Falls, but give some idea of its extended use at the Boston & Montana reduction works.

The Effect of Air in Zinc-Dust Precipitation Systems

BY D. W. MINIER*

In precipitating from cyanide solutions by means of zinc dust, the admission of air to the precipitation line and presses must be carefully avoided. Upon starting one Arizona mill there was absolutely no precipitation when the solution was pumped through the presses. The pressure rose to over 25 lb., with the presses handling but 50% of their capacity. A careful examination at the precipitate pump showed that the zinc-feed pipe entered the solution line between the pump and the pregnant sump, permitting a large volume of air to enter the pipe



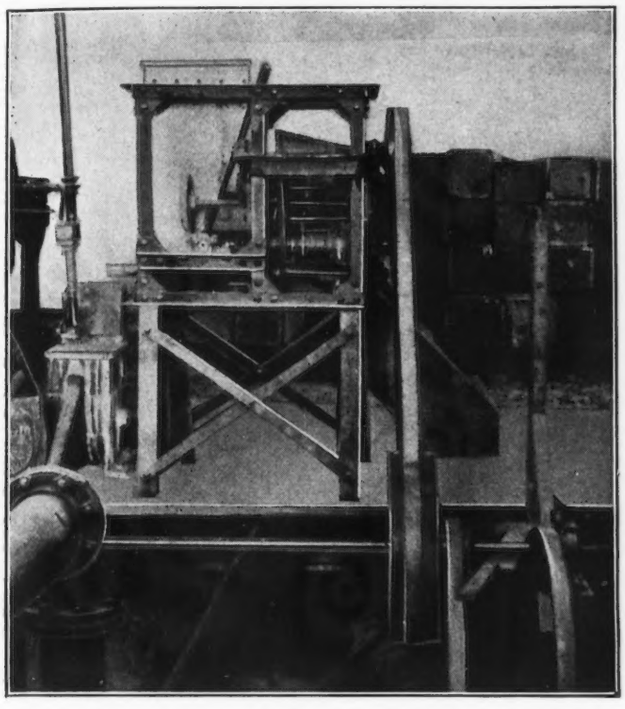
AUTOMATIC STOPPING DEVICE FOR SOLUTION PUMP

line and press. Upon correcting the piping arrangement there was no further trouble.

Another Arizona plant found that the effluent solution from the precipitation presses instead of being barren was actually 200 to 300% richer than the solution in the pregnant sump. A careful examination showed that at times the pregnant solution sump was being pumped dry, allowing large volumes of air to enter the precipitation system, and re-solution was taking place.

*Mining engineer, Pearce, Ariz.

To avoid such a possibility the precipitation system of the Commonwealth mill, at Pearce, Ariz., was equipped by B. A. Bosqui with an automatic trip to stop the motor-



ZINC FEEDER DIRECT-DRIVEN FROM SOLUTION PUMP

driven pump when the level of the solution in the pregnant sump reached a point 6 in. above the pump-suction line. The arrangement is simply a "figure-four" trip operating a knife-blade switch on one of the lead lines to a starting box. When the sump is again full, the trigger is re-set and switch engaged by hand. The starting box is used in the ordinary fashion.

As the precipitation pump is driven by a back-geared motor, the automatic feeder is driven from a belt on the pump pinion-shaft, so that the feeder stops with the stopping of the pump.

When the plant was started, trouble occurred in keeping the pump packed. Graphite and flax packing having been found useless, hydraulic packing was tried, which prevented leakage and gave long service.

Refining Base Bullion

BY WM. SEWARD MANN*

The output of many small mills is retorted and melted in the ordinary blacksmith forge, and it is often a question of finding the simplest method of refining bullion containing the bits of steel and wrought and cast iron which come from a broken crucible. Commercial sulphur may be used and is best pulverized to pass a 60-mesh screen. As wrought iron and steel melt at a higher temperature than gold, the contents should be brought to a bright red and the powdered sulphur slowly added. After two or three additions the matte which is formed is skimmed and then more sulphur added, this process being continued until but little matte forms. If inconvenient to skim, the charge can be poured together with the matte, cooled until the metal is chilled and a greater part of the matte poured, as it melts at a lower temperature.

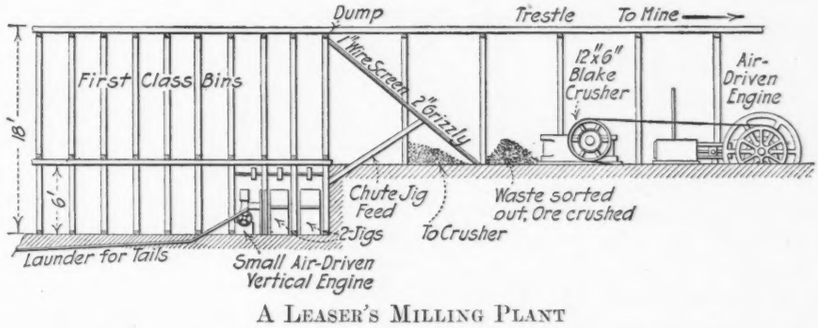
Before pouring, the contents of the crucible should be vigorously stirred with an iron rod to take up any free sulphur that may be present. The mold should be heated just too hot to handle with the bare hands. It may then be smoked evenly by inverting over a fire of cotton waste and oil, lubricated with paraffin or painted with bone ash. As soon as the slag has assumed a deep red, the mold and the contents should be plunged into cold water. This sudden cooling will cause the bar to loosen and oftentimes the slag to separate. If it does not, it can easily be detached by a sharp tap with a hammer if done while the bar is still hot. Should there be a thin film of matte remaining it can be removed by heating to a dull red and plunging into dilute sulphuric acid, or better, if potassium nitrate is sprinkled on the bar, nitrates will be formed which are soluble in water. If a black film or tarnish still remains on the bar, this can be removed by immersing in a dilute solution of sulphuric acid to which has been added a small quantity of common assay soda and giving a vigorous scrubbing with a stiff brush. The matte formed may carry some silver, and if much is produced it had better be saved and sold to a smelting plant.

*Cisco, Placer County, Calif.

A Leaser's Milling Plant

BY S. S. ARENTZ*

A small plant used by leasers at the Honerine mine of the Bullion Coalition Mines Co., Stockton, Utah, serves



A LEASER'S MILLING PLANT

the purposes for which it was built, and cost less than $1000. The saving is excellent.

The ore is siliceous silver-lead material, containing much limonite. Lead is in the form of galena with some carbonate, and it runs from 6 to 20%, with 2½ to 10 oz. Ag per ton. The illustration shows the plant in detail. The grizzly has two compartments, the fines going at once to the jigs; and the medium size, too fine for sorting but too large to send to the jigs, is put through the crusher. The grizzly oversize is hand-sorted, and the good ore crushed. All material is moved by hand from the crusher floor to the crusher, and again into the jig-feed bin.

The top of the trestle and the ore bins form a roof over the plant, and canvas tacked on the trestle bents gives sufficient shelter on the sides. All the machinery is second-hand, but good for much service.

*Mining engineer, Dooly Building, Salt Lake City, Utah.

The Assayer and Chemist

The Phosphate Method for Alumina

By F. G. Hawley*

The determination of alumina is of almost daily occurrence in many metallurgical laboratories. Nevertheless its assay is one of the least satisfactory that the chemist is ordinarily called upon to make. During recent years the phosphate determination for alumina, a direct method and well adapted to use on most complex ores, has come into general favor.

By carefully following standard directions an experienced analyst can usually obtain good results, but a chemist having many determinations to make and using some of the shortened commercial methods will frequently find that he does not check by 1 per cent. or more.

During the last six years I have had to make many alumina assays by the phosphate method and naturally wanted as much information on the subject as possible.

As the literature on the subject is not extensive and some of it is contradictory, it was thought that the subject was one that justified considerable research. A great deal of study was given to the question and nearly 200 experiments made in testing different phases of the method. Considerable information was obtained. A new method to separate aluminum and iron hydroxides from copper was devised and several of the details of standard methods were modified to meet special requirements.

Influence of Fluorine

One of the first things investigated was the interference of fluorine. It was found that even minute quantities would seriously interfere with the accuracy of the results. My attention was called to this fact by noticing that when making alumina determinations on reverberatory slags that had been decomposed by HF and H_2SO_4 the results were frequently much too low. The slag was decomposed in a platinum dish and at the end was heated to strong fumes of SO_3. Theoretically the fluorides should have been completely decomposed but I judged that such might not always be the case and that possibly some fluorine might remain and cause incomplete precipitation of the alumina.

The following experiment was made: 2.5 grams of slag were decomposed by a carbonate fusion; evaporated to dryness with HCl, and the SiO_2 filtered out; the solution diluted to 500 c.c., and then divided into five equal parts. All were run by the regular phosphate method and treated alike except for the HF.

No. 1—No addition, found 10.6% Al_2O_3.
No. 2—No addition, found 10.6% Al_2O_3.
No. 3—1 drop HF added, found 6.7% Al_2O_3.
No. 4—2 drops HF added, found 4.8% Al_2O_3.
No. 5—4 drops HF added, found 0.8% Al_2O_3.

The experiment was repeated with similar results. I thought that the alumina might be precipitated by ammonia, filtered from the ammonium fluoride and then dissolved and precipitated as phosphate. Experiments to test this showed that even when as little as 0.005 gram of fluorine was present, enough was always retained by the hydroxides to affect the determination. The results were from 0.6% to 1% too low.

When it is desired to decompose a sample with HF preparatory to making an alumina determination it is best to evaporate with H_2SO_4 twice to dryness to insure complete expulsion of all fluorine. Under these conditions good results may be obtained.

Influence of Cu, Sb, As and Pb

Most authorities state that these metals will interfere with the phosphate method and usually recommend that they should be removed by precipitating with H_2S. When many samples are to be assayed the use of H_2S is a disagreeable and tedious operation and many chemists dispense with its use whenever possible. Instead of using H_2S from a generator some chemists generate it in the assay by adding sodium sulphide to the acid solution. The sodium sulphide should be tested as it often contains impurities. Lead is frequently removed as sulphate, and copper by precipitating the alumina by ammonia; most of the copper going in the filtrate.

Numerous experiments proved that when copper, antimony and arsenic are present they will be precipitated as sulphides when the solution was boiled with "hypo" to precipitate the aluminum phosphate.

Lead appeared not to be precipitated under the conditions of the assay, but as comparatively few experiments were made with lead the results may not be conclusive.

Fortunately these metals when present, even in small quantities, make their presence known by the distinctive colors their sulphides give the solution, 0.3-0.4% being readily noticed. On igniting these sulphides they are changed to oxides. The copper oxide all remains with the aluminum phosphate, the antimony mostly so, as little volatilizes, but the arsenic being volatile, is entirely expelled. Although some authorities recommend differently, I find it unnecessary to eliminate As before precipitating $AlPO_4$ as its volatility insures its complete removal.

The following experiments show the amount of error caused by Cu, Sb, As and Pb:

	Al_2O_3 Taken	Added	Al_2O_3 Found
No. 1	0.0550 gram		0.0550 gram
No. 2	0.0550 gram		0.0552 gram
No. 3	0.0550 gram	—.01 gram Cu	0.0605 gram
No. 4	0.0550 gram	—.02 gram Cu	0.0660 gram
No. 5	0.0550 gram	—.02 gram Sb	0.0695 gram
No. 6	0.0550 gram	—.05 gram Sb	0.0820 gram
No. 7	0.0550 gram	—.05 gram As_2O_3	0.0545 gram
No. 8	0.0550 gram	—.10 gram As_2O_3	0.0550 gram
No. 9	0.0550 gram	—.02 gram Pb	0.0542 gram
No. 10	0.0550 gram	—.10 gram Pb	0.0540 gram

Copper when present in small amounts may be removed sufficiently well for most work by a single ammonia separation, but when there is much present, two or even more precipitations may be required before it is entirely eliminated.

New Method for Eliminating Cu

An original method for complete separation of copper from iron and aluminum hydroxides has been devised,

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which gives entire satisfaction. It is particularly well adapted to use on copper concentrates and any other material containing alumina together with much iron and copper. Either iron or alumina can be determined in the hydroxides thus freed from copper, and lime and magnesia can be determined in the filtrate.

To make the separation proceed as follows: Put the hydrochloric-acid solution of the aluminum and iron hydroxides, containing at least 20 c.c. of HCl, in a 300-c.c. beaker; add ammonia very carefully until neutral and then 4 c.c. excess; add slowly and with constant stirring a solution of KCN (about 40 grams per liter) until the blue color of the copper has nearly but not quite disappeared. If there are a number of samples it is a good plan to add a little KCN to each one and then beginning at the first a little more, repeating this a number of times until finished. Working in this manner there is little danger of overrunning as the first sample will have partially settled by the time the last one is reached so that the amount of blue can be easily seen. The beakers are now covered and heated on the hot plate to boiling; the boiling is continued for two minutes and then the sample removed and settled a short time. The samples are filtered and well washed with hot water. The hydroxides are now ready to be dissolved in HCl and the alumina precipitated by the regular phosphate method. If the KCN is added too fast or too much is used some of it will combine with the iron forming ferrocyanide and this will cause trouble later by forming prussian blue, but if the KCN is used as directed very good results are certain. The following experiments were made to test the efficiency of KCN in preventing iron and aluminum hydroxides from retaining copper. Each sample contained 0.170 gram Cu; 0.160 gram Fe and 0.050 gram Al_2O_3; 10 c.c. HCl was added and then neutralized with NH_4OH and 8 c.c. excess added. Samples were boiled, filtered and washed six times with hot water.

No. 1—KCN added 27 c.c., Cu in hydroxides—trace
No. 2—KCN added 25 c.c., Cu in hydroxides—0.0010 gram
No. 4—KCN added 10 c.c., Cu in hydroxides—0.0122 gram
No. 5—KCN added 0 c.c., Cu in hydroxides—0.0254 gram

A previous test had shown that it took 27.5 c.c. of KCN entirely to decolorize the solution.

Effect of Impurities

When a sample contains antimony it is possible to eliminate it by volatilizing as $SbCl_3$. While this method has little advantage over that of removing the antimony by H_2S, there may be times when a generator for H_2S is not available and it would be desirable to use this separation. The method is as follows: Put the sample in a casserole with 0.5 gram NaCl and 10 c.c. HCl and evaporate to dryness and heat to 220 to 250° C. for 5 min. The antimonious chloride formed is volatile at this temperature. If there is enough sodium chloride present to form the double salt the aluminum chloride will suffer no loss. The temperature can be known sufficiently close by means of a beaker containing a little H_2SO_4 placed near the assay. It is hot enough when the H_2SO_4 fumes rather strongly but does not boil.

Effect of Other Metals

Experiments were made to determine what effect the presence of Zn, Mn, Ca and Mg would have on the assay. The tests indicated that these elements had no effect on the accuracy of the results.

As iron is one of the metals most commonly associated with alumina it is important to know what effect it will have on the assay. It was found when the assay is made exactly according to the standard directions usually given, that iron, even when present in considerable amount, will not materially affect the results. One of the conditions usually required is that the solution should be diluted to 400 c.c. before precipitating the alumina. On account of the length of time required to boil and filter so much solution it is a common practice with many chemists to use less.

However, experiments seem to prove conclusively that this is bad practice, especially when much iron is present, as the aluminum phosphate is always contaminated with iron.

These experiments show how the results are affected:

	Al_2O_3 Taken	Added	Bulk	Al_2O_3 Found
No. 1	0.0350 gram	.....	400 c.c.	0.0352 gram
No. 2	0.0350 gram	.....	400 c.c.	0.0354 gram
No. 3	0.0350 gram	0.270 gram Fe	400 c.c.	0.0354 gram
No. 4	0.0350 gram	0.270 gram Fe	400 c.c.	0.0356 gram
No. 5	0.0350 gram	0.270 gram Fe	300 c.c.	0.0366 gram
No. 6	0.0350 gram	0.270 gram Fe	200 c.c.	0.0382 gram

It is a well known fact that when alumina with iron is precipitated by means of ammonia and ammonium chloride that the small amount of silicic acid that is almost invariably present in the solution will be almost entirely precipitated with the alumina. If the hydroxides are ignited and the Al_2O_3 determined by the difference method the results will be slightly too high unless allowance is made for the SiO_2 present. Although this will frequently amount to several milligrams, it is usually neglected in the commercial assay. It was proved by several tests that when a small amount of silicic acid is similarly present in solution in the phosphate assay that the SiO_2 is not precipitated with the alumina. This is one reason why some chemists have claimed that the phosphate method gives low results.

In conclusion I would say that I consider this method entirely reliable and the best for general work. The only exception I make to this is in the case of samples containing over 15% alumina, little iron and no appreciable amount of phosphorus or other interferences. In this case I consider it better to make a double ammonia precipitation, weigh the combined oxides and deduct the iron oxide.

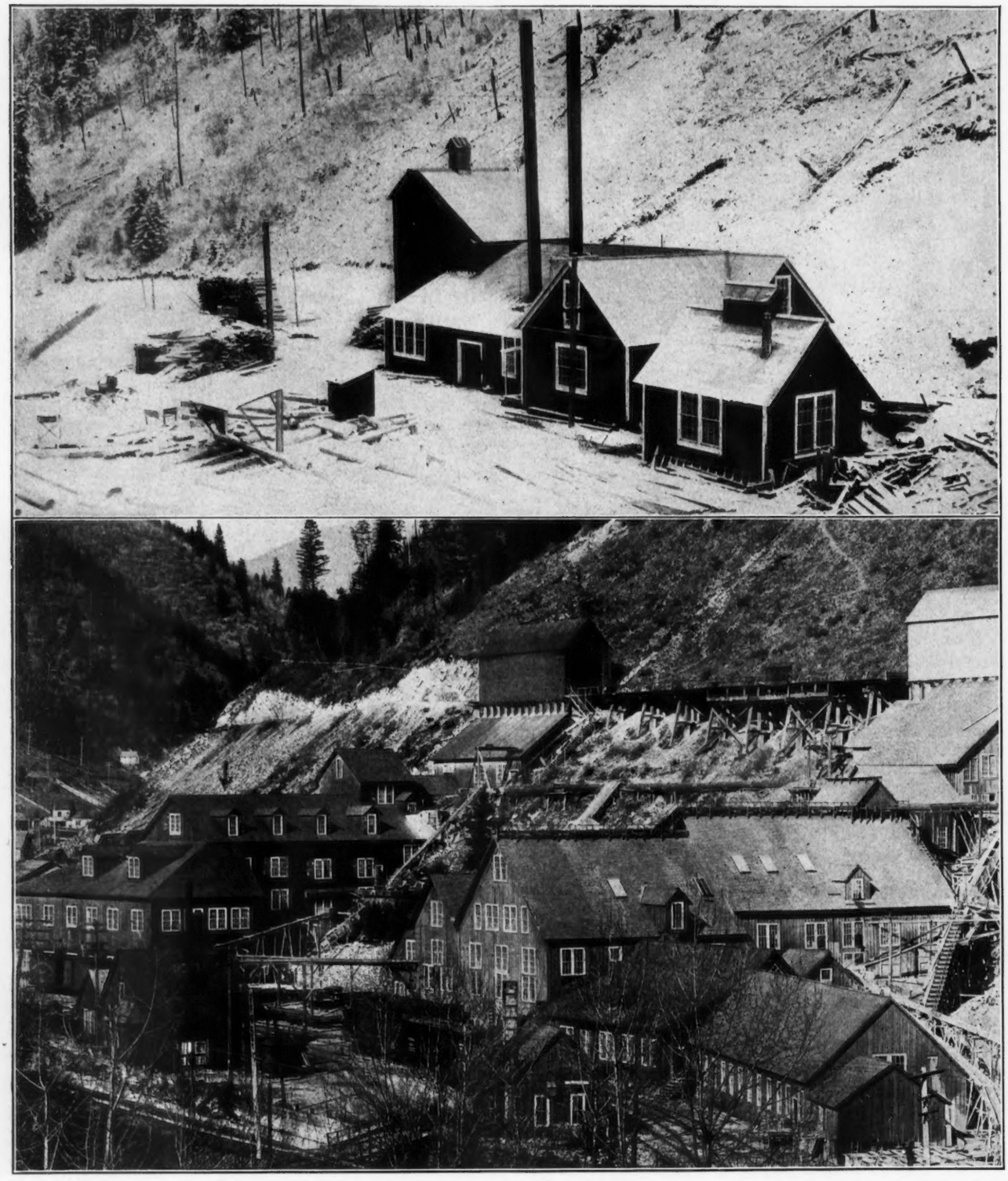
Reduction Test for Tungstic Acid

Some simple prospectors' reduction tests for tungstic acid are described by G. Torossian (*Am. Journ. Sci.*, December, 1914, p. 537) from which two are selected.

Place the powdered substance on a piece of aluminum plate or foil; moisten with a drop or two of water; then add a drop or two of concentrated hydrochloric acid. A blue color, which develops even in the presence of oxidizer and ferric oxide, shows tungsten.

Another test is: Place water in single big globules (not spread out) on aluminum foil; sprinkle a little of the finely powdered material on them, and add a little hydrochloric acid to the globules. A blue color, developed in the presence of insoluble carbonaceous material, copper oxide, hematite. lead oxides, sulphur, rare-earth oxides or calcium fluoride, shows tungsten.

Photographs from the Field



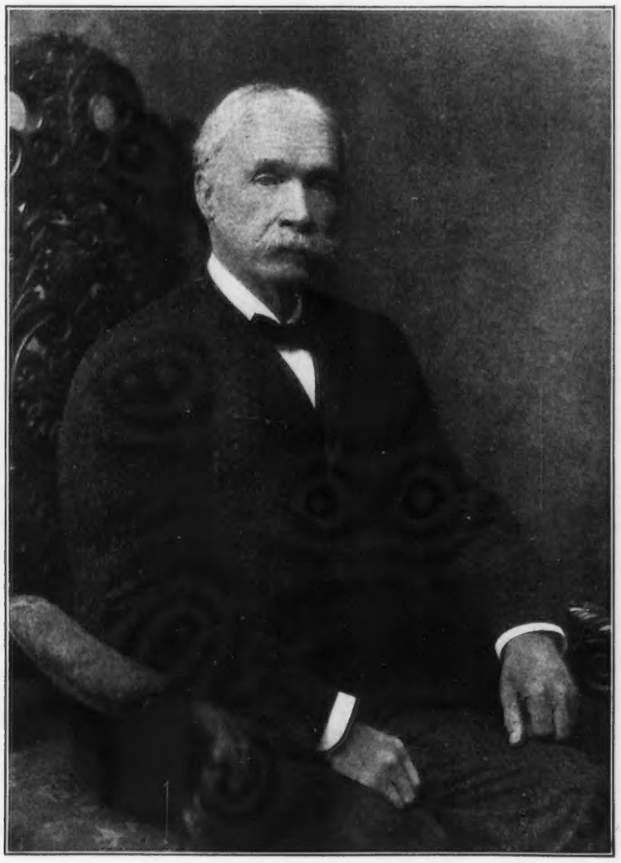
IN THE CŒUR D'ALENE DISTRICT

Surface plant at the Corrigan mine. Lower view is of the Green Hill-Cleveland and the Stewart concentrators at Wallace; the latter distinguished by the arrow. Both plants belong to the Federal Mining & Smelting Co.

AT THE HERCULES MINE, BURKE, IDAHO

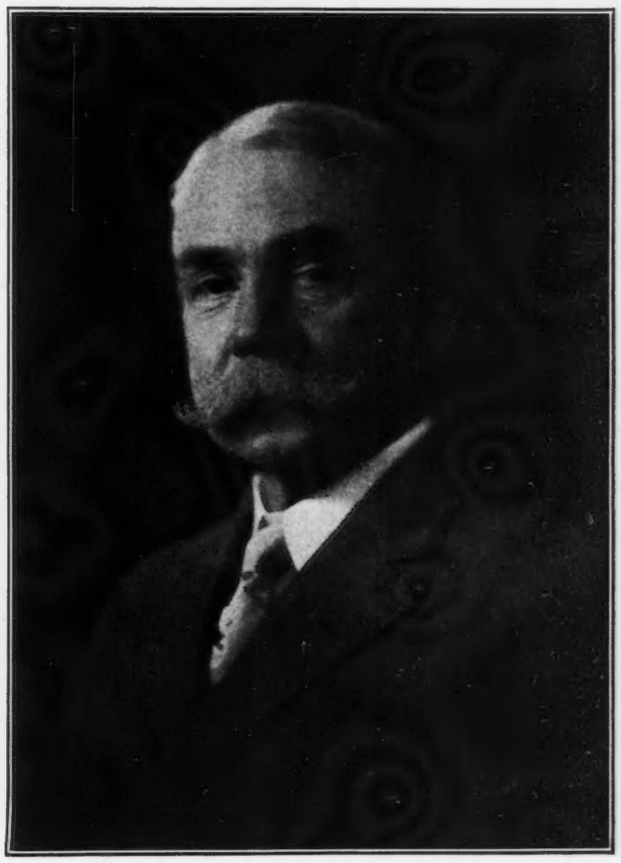
This mine operates its own sawmill, providing timber for all purposes

Men in the Public Eye



ROBERT HALLOWELL RICHARDS

Awarded the gold medal of the Mining and Metallurgical Society of America for distinguished service in the advancement of the art of ore dressing.



PHILIP N. MOORE

Elected first vice-president of the American Institute of Mining Engineers. Mr. Moore is a distinguished mining engineer, whose home is in St. Louis.

Pig-Iron Production in 1914

The full statement of production as given in *Bulletin* No. 1 for 1915 of the American Iron & Steel Association gives the total make of pig iron in the United States in the second half of 1914 at 10,796,150 long tons, making the total for the year 23,332,244 tons, which is a decrease of 25% from that of 1913. The *Bulletin* says that in these totals all pig iron and ferroalloys are included, whether made in blast furnaces or in electric furnaces. Pig iron made with bituminous coal is included under coke pig iron. Pig iron made with mixed anthracite and coke is included in anthracite pig iron. Pig iron made with coke and electricity is included in coke pig iron; that made with charcoal and electricity is included in charcoal pig iron. Low-phosphorus pig iron—that is, iron running under 0.04 P—is included in bessemer pig iron. Pig iron containing from 0.04 to 0.10% P is classified as bessemer. The figures for 1913 and 1914 include under basic iron a small quantity of charcoal iron of basic grade. In 1912 and prior years charcoal pig iron of basic quality was not included in the basic production. Nearly all the charcoal iron is classed as foundry pig iron. Ferrosilicon is included in foundry pig iron. Pig iron containing 7% or over of silicon is classified as ferrosilicon.

Under the old classification by fuels used the production for two years past has been as follows:

	1912	1913	1914
Coke	29,132,733	30,348,973	22,976,856
Anthracite	247,179	277,347	91,464
Charcoal	347,025	339,832	263,924
Total	29,726,937	30,966,152	23,332,244

A few small furnaces using raw bituminous coal are included in the coke stacks; their production is too small to make it worth while to separate them. Nearly all the anthracite stacks use some coke mixed with the coal. Of the charcoal iron reported, 9294 tons were made with cold blast and 254,630 tons with hot blast. Practically 98% of our pig iron was made with coke as fuel.

The following table shows the production of iron by grades, and also the proportion made by the steel works' furnaces for their own use and by the merchant furnaces for sale in 1914:

	For Use	For Sale	Total	Per Cent.
Basic	8,190,966	1,479,721	9,670,687	41.5
Bessemer	7,331,222	527,905	7,859,127	33.7
Foundry	140,165	4,393,089	4,533,254	19.4
Malleable	.....	671,771	671,771	2.9
Forge	165,593	196,058	361,651	1.5
All other	141,318	94,436	235,754	1.0
Total	15,979,264	7,362,980	23,332,244	100.0
Total, 1913	21,232,063	9,734,089	30,966,152	....

Included in the "all other" kinds are 79,035 tons of spiegeleisen, 106,083 tons of ferromanganese and 49,736 tons of white and mottled iron, direct castings and miscellaneous ferroalloys. Merchant iron was 31.6% of the total in 1914 and 31.4% in 1913, or practically the same proportion in both years.

The methods by which pig iron was cast or otherwise delivered from the furnace were as follows in 1914:

Delivered	Tons	Per Cent.
Molten to steel furnaces, etc.	11,911,247	51.0
Sand cast in pigs	4,814,959	20.6
Machine cast	5,854,661	25.1
Chill cast	738,018	3.2
Direct castings	13,359	0.1
Total	23,332,224	100.0

Basic and bessemer were naturally the classes of iron most largely delivered in molten form. Of the basic iron made, a total of 6,436,146 tons, or 66.5%, was so delivered; of the bessemer pig, 5,467,687 tons, or 69.6%. Outside of the steel-making irons only 7414 tons were delivered in molten form.

The production by states is given as follows for two years:

States	1913	1914
Pennsylvania	12,954,936	9,733,369
Ohio	7,129,525	5,283,426
Illinois	2,927,832	1,847,451
Alabama	2,057,911	1,826,929
New York, N. J.	2,187,620	1,559,864
Ind., Mich.	1,775,883	1,557,355
Wis., Minn.	367,326	329,526
Virginia	341,815	271,228
Mo., Col., Cal.	324,263	267,777
W. Va., Ky., Miss.	315,731	236,393
Tennessee	280,541	216,738
Maryland	289,959	195,594
Conn., Mass.	12,810	6,594
Total	30,966,152	23,332,244

Pennsylvania made in 1914 the largest proportion, 41.7% of the total. Ohio made 22.6%; Illinois, 7.9, and Alabama, 7.8%. There were no great changes among the states, except that Alabama increased its proportion, having a lesser decrease than any other state.

Present Operations of Great Northern Iron Ore Properties

SPECIAL CORRESPONDENCE

The Great Northern Iron Ore Properties is at present operating the following mines in the Mesabi Range in Minnesota:

The Thorne property is a new operation, situated near Buhl. Sinking of the shaft was completed early in the winter, since which time development underground has been continued. The ore in this property developed to date is unusually hard for the Mesabi Range, and the management is contemplating the installation of an air compressor and Jackhamer drills. Butler Bros. is making an ore approach into the Dean mine, also situated near Buhl, which property was transferred last season to the Tod-Stambaugh interests, and will be operated during the coming year by the Dean Iron Mining Company.

At the Dunwoody property, near Chisholm, stripping operations will soon be resumed by Winston & Dear. Ore is now uncovered in portions of this pit, and this property will be in shape to ship a considerable tonnage this season. The Leonard property, also near Chisholm, is hoisting a large tonnage through its No. 2 shaft; and the North Bank of the openpit portion of the mine, which lies north of the No. 2 shaft workings, is being rapidly developed. This property is in shape to ship from the openpit during the coming season.

Near Hibbing, underground operations are being carried on in three properties—the Harold, the North Uno, and the Dale. The Harold, which is producing heavily, is owned in fee by the Great Northern Iron Ore properties. The two other properties are owned in fee by the Northwestern Improvement Co., and are being operated as a separate company, but under the direction of the officials of the Great Northern. These two operations are confined to underground ore areas which are a continuation of the orebodies which have been largely removed by the Oliver Iron Mining Co. in openpit mining. The Smith property, which is part of the above group, is now stripped and ready for openpit steam-shovel mining. There is still remaining a comparatively small tonnage of openpit ore in the Dale, North Uno and South Uno

openpits, which were operated last season by the Oliver Iron Mining Co., but which will be operated in the future by the Great Northern. The Mississippi mine, an underground property, located near Keewatin, is operating at full capacity. A. Guthrie & Co., stripping contractors, who were given the stripping contract on the Hill-Annex property near Marble last season, ceased operations in January, but will resume early in March, after which these operations will be pushed to the fullest possible extent.

Developments at Atlanta, Nev.

By Paul W. Meyers*

The Atlanta gold camp is situated in the northeastern part of Lincoln County, Nev., at an elevation of 6700 ft. It is about 45 miles north of Pioche and about 65 miles south of Ely, being connected with both camps by good wagon roads. Within a mile or two of Atlanta is the old silver-mining camp of Silver Park, which flourished in the '70s.

Boulders carrying free gold were discovered at Atlanta seven or eight years ago, and large outcrops located. The first shaft was sunk by George M. Latimer to a depth of about 60 ft., and in June, 1909, an option was taken on the property by Elmer M. Bray and associates, of Los Angeles, and active development begun. A Nevada "boom" ensued. The original group of claims was promptly surrounded on every side by locations, and the country was dotted with discovery holes. Rumors were in circulation of a projected railroad from Ely to Pioche, passing near Atlanta, and signs of returning animation appeared at abandoned properties in the surrounding country. But Atlanta is a low-grade camp, and the boom subsided.

In the meantime Mr. Bray and his associates exercised their option, and in the latter part of 1911 organized the Atlanta Consolidated Gold Mining Co., which, after a period of inactivity, resumed the work of development and is now proceeding with a small force of men.

The outcroppings on the Consolidated property are on the west slope of a mountain which rises to a height of between 500 and 600 ft. above the valley, the prominent croppings being near the foot. Above these croppings the mountainside is of limestone, while porphyry appears below. The orebody appears to be in the altered limestone lying along a porphyry contact which has a general north-south strike and dips west at about 45°, although strike and dip are so far indeterminate.

The most characteristic feature of the orebody is its brecciation. The length of the outcrop as indicated by outcropping masses of breccia is possibly 3000 ft. The width of the brecciated zone is over 100 ft. To the south of the present workings the masses of breccia which appear on the surface carry angular fragments of chalcedony. The gold varies with the degree of alteration, and where manganese predominates it seems to diminish.

There appear to be no definite limits to the orebodies. The outcrops wherever sampled have carried small amounts of gold. Two shafts, 300 ft. apart, have been sunk on the lower side of the two most prominent outcrops near the contact with the porphyry, and crosscuts from these shafts have shown ore of commercial grade only a short distance below the surface. The gold is largely in the free state and finely divided, so that pan tests would lead one to suppose a higher grade than that shown by subsequent assay. Developments to date have shown the lateral limits of commercial ore to have a dip corresponding to the dip of the porphyry contact, but the width of commercial ore in the brecciated zone is determined only by sampling, the values sometimes changing abruptly, but usually grading off gradually.

The workings in the two shafts comprise about 1500 ft., but the deepest development to date is only 215 ft. All the workings are dry. On the 200-ft. level the brecciated zone appears more oxidized and leached than on the 100-ft. level, with much manganese, some barite and traces of copper, but no sulphide minerals appear. The width of ore shown by sampling the main crosscut on the 200-ft. level is about 80 ft. The average gold content is lower than on the 100-ft. level, while the silver content is higher. The average grade of the ore shown to date depends upon the width considered. From careful samplings it can be conservatively stated that the workings in general show a width of 55 ft., which will average between $3.50 and $4.50 per ton, while the upper levels of both shafts show higher-grade portions of the orebody from 25 to 30 ft. in width, averaging from $5.50 to $7 per ton.

Looking across Atlanta Camp from No. 1 Shaft

The Atlanta Consolidated property is still in the development stage, with its future depending upon showing at depth. However, the widths of commercial-grade ore shown justify the hope that the property will contain much low-grade ore. Should this be realized, general conditions should permit operations at a low per-ton cost. It is probable that $3 ore can be mined and milled at a profit, based on the adaptability of the ore to cyanidation, and the feasibility of a hydro-electric power installation with a 35- to 40-mile transmission line. There are springs and small creeks in the district which would supply ample water for milling and cyaniding.

At present there is nothing going on at Atlanta except the rather limited operations of the Atlanta Consolidated and performance of assessment work by owners of sur-

*2030 Land Title Building, Philadelphia, Penn.

rounding claims, who are awaiting developments at the Consolidated property. These developments should be of interest to the mining world, as they may result in adding another successful low-grade gold property to the list of such enterprises.

"Safety First" at Butte Mines*

Safety-first work at mines meets with more difficult problems and different conditions than are experienced in mills, smelting works and shops; or, to make it more general, the men who work underground have a greater variety of chances for accidents than are met with in surface operations of any kind. On the surface, men have a general order of action in their work and fixed conditions in regard to their surroundings, while in the mine the scenery changes every shift and in a majority of cases many times a shift.

At Butte, underground as on the surface, efforts were first made to establish a set of rules concerning certain precautions to be taken in the work and the posting of many printed signs of warning. This was an easy thing to do. The troublesome part of "safety first" is the enforcement of these rules or the education that the great majority of men in mines need. Carelessness is the worst fault that a miner has, and until that is eliminated accidents will continue.

It is impossible to make every place in the mine "foolproof," because the surroundings change day after day. Guard rails and grizzlies at chutes and manways save many careless miners. Overhead stringers and lagging save others. Gates on cages and stations, inspection of machinery and tools, the best of material to work with, better sanitary conditions and bosses interested in "safety first" are protections which the company is giving the men.

On the first of each month a meeting is held, which all foremen and shift bosses attend. At this meeting each shift boss is called upon to explain the cause of accidents to his men and to suggest safeguards and precautions that may be taken to avoid similar accidents in the future.

Believing that frequent telling has no effect upon most men, all bosses have been instructed to discharge men who do not carry out the safety-first rules and who do not immediately follow the orders given to them to make their working places safe or to guard the lives of other men. There have been several cases where men have been injured after failing to obey orders, but these men have not been discharged because the lesson they learn is regarded as sufficient for the future.

Since the first of this year there have been four men discharged at the Tramway mine for disregarding the safety rules in blasting, and two other men were laid off for not covering the chute in which they were working. At the Leonard mine two men were discharged for not cribbing bad ground over timbers under which they were working. One man was discharged for leaving the guard rail of a waste chute up, and another man for working underground without protection. At the Leonard mine, also, a man was badly injured when he failed to put in stringers after he had been ordered to do so. At the West Colusa mine two men were discharged for not going to the level above while blasting in their stope.

To many this course of discharging men in every case where they do not follow orders may seem rigid, but it is considered the only way to attain the desired results for all concerned.

*Abstract of an article in the "Anode" by Chauncey L. Berrien, assistant general superintendent of mines, Anaconda Copper Mining Co., Butte, Mont.

NEW PUBLICATIONS

METAL STATISTICS, 1915. Eighth Annual Edition. Edited by C. S. J. Trench and B. E. V. Luty. 3¾x6¼, pp. 344; American Metal Market Co., 81 Fulton St., New York, N. Y.

SUMMARY REPORT OF THE GEOLOGICAL SURVEY, DEPARTMENT OF MINES, FOR 1913. 6½x10, paper, pp. 422, illus.; R. W. Brock, Deputy Minister of Mines, Ottawa, Canada.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE, Vol. XC., No. II, 1914. Edited by George C. Lloyd, 5¼x8¼, pp. 448, illus.; Iron and Steel Inst., 28, Victoria St., London, S. W., England.

MINERALS OF PENNSYLVANIA. By Amos P. Brown and Frederick Ehrenfeld. 6x9, pp. 160, illus., Report No. 9 (1913), Topographic and Geologic Survey Commission of Pennsylvania; R. R. Hice, State Geologist, Beaver, Penn.

PUMPING BY COMPRESSED AIR. By Edmund M. Ivens. 6x9¼, pp. 244, illus.; $3. John Wiley & Sons, Inc., New York.

A handbook and descriptive treatise in a heretofore unoccupied field.

METALLURGY: A CONDENSED TREATISE FOR THE USE OF COLLEGE STUDENTS AND ANY DESIRING A GENERAL KNOWLEDGE OF THE SUBJECT. By Henry Wysor. 6x9, pp. 391, illus.; $3. Chemical Publishing Co., Easton, Pennsylvania.

ELECTRIC MINE SIGNALING INSTALLATIONS. A Practical Treatise on the Fitting-up and Maintenance of Electrical Signaling Apparatus in Mines. By G. W. Lummis Paterson. 4¾x7¼, pp. 196, illus.; $1.50. D. Van Nostrand Co., New York.

MINES AND QUARRIES: GENERAL REPORT WITH STATISTICS FOR 1913. By Chief Inspector of Mines. 8¼x13½; paper. Part II, Labor, 125 pp., illus.; Part III, Output, 139 pp., illus.; Part IV, Colonial and Foreign Statistics, 189 pp. Home Office, London, England.

A POPULAR TREATISE ON THE COLLOIDS IN THE INDUSTRIAL ARTS. By Kurt Arndt. Translated from the Second Enlarged German Edition by Nahum E. Katz. 5½x7¾, pp. 73; 75c. Chemical Publishing Co., Easton, Pennsylvania.

This has some sections on the ceramic industry, but does not otherwise touch mining and metallurgy.

THE ELECTRIC FURNACE IN METALLURGICAL WORK. By Dorsey A. Lyon, Robert M. Keeney and Joseph F. Cullen. Pp. 216, illus. Bull. 77, U. S. Bureau of Mines, Washington, D. C.

Contents: Design, construction and operation of electric furnaces; the smelting of metals in the electric furnace; the manufacture of ferroalloys in the electric furnace.

THE CYANIDE HANDBOOK. By J. E. Clennell. Second edition, revised and enlarged. 6x9, pp. 601, illus.; $5. McGraw-Hill Book Co., New York.

In this edition Mr. Clennell has taken advantage of the opportunity to include all of the developments and improvements, which are many, since the first appearance of the work. It remains the best general basic treatise on the cyanide process; not better than before, since that is hardly possible, but more up to date. If any criticism were to be made, it would be that the book is not practical enough for the ordinary workman, but it is not to be expected that the same work should be suitable to all conditions. As a complete exposition of the scientific basis of cyanidation, and a review of its application in general the book is supreme.

INDUSTRIAL CHEMISTRY. A Manual for the Student and Manufacturer. Edited by Allen Rogers. Second edition, revised and enlarged. 6¼x9½, pp. 1025, illus.; $5. D. Van Nostrand Co., New York.

The principal subjects discussed are: General processes; water for industrial purposes; fuels; sulphuric acid; chlorine and allied products; electrochemical industries; lime, cement and plaster; clay, bricks and pottery; glass; white lead; zinc oxide; pigments and paint oils; mixed paints; fertilizers; illuminating gas; coal tar and its distillation products; the petroleum industry; lubricating oils; soaps and soap powder; glycerine; shellac; rubber and allied gums; varnish; sugar; starch, glucose, dextrin, and gluten; brewing and malting; wine making; distilled liquors; textiles; dyestuffs and their application; explosives; leather; glue and gelatine. The work contains many other chapters, and each subject is treated by a recognized authority in its field. It is a useful reference work for anyone coming into contact with the commercial side of chemistry.

Correspondence and Discussion

Why Is the Patent Mania?

Referring to Stuart Croasdale's article in the JOURNAL of Jan. 30 on "Why is the Patent Mania, or Why the Patent Office?" it is doubtful if his views will be shared by many who have had occasion to work along patent lines.

Except for certain defects, which it is hoped will soon be remedied, it is difficult to see how the present patent system could be greatly improved. If the restrictions suggested by Mr. Croasdale were carried into effect, so that only basic principles or radical improvements could be patented, the entire patent system would be nullified, and this is one of the greatest calamities that could happen in the United States. What is a "basic principle," and what is a "radical improvement"? How is it to be decided? Who is to decide? There is only one way in which an ineffectual attempt could be made, and that would be to go through a regular court proceeding for every patent application. This would mean that every patent would have to be litigated instead of comparatively few. The result would be that men of ordinary means who had intellectual property to protect could not protect it, and that would mean an end to the entire patent system, for, after all, it has been the men of very ordinary means who conceived and patented most of the great inventions.

Take the cyanide process, for example: There are two sets of patents which, if any, would come under the class of "basic" and "radical improvement"; these are the original MacArthur-Forrest patents and the suction-filter patents. The MacArthur-Forrest patents made the cyanide process workable, and the suction filter revolutionized and broadened its application. Few metallurgical patents have been the cause of as much litigation as these, and yet after all testimony bearing on the subject had been thoroughly threshed out in the courts the patents were sustained in some countries and defeated in others. Even in the same country there was no unanimity of opinion. How then can the patent office decide on the merits of the case when an application is presented to it? No one ever yet invented anything so wonderfully new that some had not thought along somewhat similar lines before. It is for this reason that the Government regards all patent applications as an "improvement" in the art. Is it not an absolute fact that it is mostly the patents which are termed "basic" or "radical" that are most bitterly contested?

The present patent system is by far the best. If the patent office has a reasonable doubt as to the merits of an application, the applicant should be given the benefit of the doubt. Certainly if a man has a questionable right to intellectual property, he should have the same privilege of establishing his right as a man who may have a questionable right to material property. It costs the man to defend his patent quite as much as it costs the man he claims is infringing, and no patentee is going to commence infringment proceedings, and meet the expenses incidental thereto, unless he is well advised.

Practically everything used in the metallurgical art is either patented or has been patented. If a user buys a metallurgical machine which is modern and up to date, whether he knows it or not, he is certainly paying for the patented improvements, and the only way to avoid it is to take the art as it was 17 years ago. Take, for example, a modern MacDougall furnace. It is questionable if any of the patents now in force on the MacDougall type of furnace would come under the head of "basic" or "radical," and yet it is precisely these patents that have made the MacDougall type of furnace what it is today. It is only right, therefore, if a user wants the benefit of those patented improvements that he should pay for them, or if he does not want them, to build a MacDougall furnace as it was 17 years ago or make his own improvements. No one denies him that privilege.

The import of a patent is never known until it has been thoroughly exploited, and patents are not usually exploited at least until the application is acted upon. Even inventors themselves are usually ignorant of the full significance of an invention or its best application at the time of filing; then how is the patent office to decide on its true merits? Few patents, indeed, are fully exploited until much of the time allotted to them has expired.

It is a fact also that ideas lie dormant until someone with energy and willingness to sacrifice comes along and shows their utility and gives them definite shape, and then the literature of the entire world is ransacked to show that there is nothing new under the sun.

No class of men, taken as a whole, gets as little from the Government for their labors as patentees. Let us compare, for example, the privileges of a patent with other governmental privileges—locating mining claims, for example. If an inventor applies for a patent—that is to say, for what he regards as intellectual property—the United States, the English and the German patent-office records are at once ransacked to see that he does not get anything that does not belong to him. If anything anticipating him is found in the literature on the subject or in the domestic or foreign patent-office records, his application is denied. He must in truth be the original and first inventor or at least establish a reasonable doubt, and then he is given a right for 17 years, which right may be attacked or questioned in the courts at any time. And this is as it should be, because the other fellow may have some rights in the matter.

Now suppose a man wants to get material property—say a mining claim. If the claim has been "discovered" a thousand times, and he is the one thousand and first one to locate, he is still the "discoverer" in the eyes of the law, and so far at least as the government is concerned, he may acquire the property for himself and his heirs forever, and a patent having once issued its validity cannot be questioned. If the same rules were to apply to the location of mining property as apply to process or apparatus patents, a mineral deposit, once discovered and then abandoned, should never again be open to location.

What, then, is the use of saying that a man who has a process or apparatus patent has more than he is entitled to? All he gets, at the best, is the privilege of establishing his rights in the courts. Before a patent is issued the records are pretty thoroughly searched, and it is not an easy matter to get a patent on an application that does not possess merit and originality. It is true that shrewd patent attorneys sometimes get patents that should not be allowed, but no scheme is entirely free from error. It will also be found that the patent office draws a strict line between "combinations" and "aggregations" and that it is difficult to put through an application on mere "aggregation."

It is a question whether any patentee ever got fees or royalties that did not belong to him. Certain it is that until quite recently patentees were obliged to be public benefactors, for in many cases patents have expired and the inventors passed into the Great Beyond before the final court decision was awarded, and many inventors were deprived of their rights through mere exhaustion. Unless an investigator can get ample protection he will not investigate, and the metallurgical art, above all others, owes much, if not everything, to patentees. The patentee himself is usually the one to get the least benefit.

The liberal patent laws of the United States have done much in making the Americans the foremost inventors in the world. Any defects in the patent system should be remedied from time to time, but it certainly would be a grievous mistake to make a radical departure.

There is a bill now before Congress to insert a two-year working condition in the patent laws. If such a bill is passed the patent system might as well be abolished. All the Latin republics of South America have such working provisions, and do they present an enviable example? How many patentees could faithfully comply with a two-year working condition? Probably not one in a hundred, especially in chemical and allied metallurgical patents. And if the working conditions are nominal, as in the Latin-American republics, why burden the poor devil of an inventor with such an unnecessary graft? For graft is all it would be. Why issue a patent at all, if there is such a string to it? Either the inventor is entitled to his intellectual property or he is not; if not, he should not be given a patent, and if he is, his possession should be as absolute as the Government can make it. Patent litigation is even now burdensome enough, but this is not even a circumstance to what it would be if a working clause were inserted in the patent laws. So long as an individual can hold a piece of ground indefinitely without improving it, and so long as an individual can hold patented mineral land without improving it, so long, at least, should a patentee of a process or apparatus be entitled to his intellectual property under the same conditions for 17 years.

What is most needed in patent reform is a technical patent court to hear patent cases and expedite patent litigation. And in addition to this, a patentee should be obliged to show diligence in acting against infringers, and if he does not show diligence, fees, royalties and damages should be limited to such a time as would be dictated by diligence—say two years. He should not be allowed to threaten indefinitely and not bring action, nor should he be allowed to let the infringement proceed indefinitely, and then expect to collect years of back fees and royalties on accounting. Both the patentees and the public would be greatly benefited if these two evils of the present patent system could be remedied.

W. E. GREENAWALT.

Denver, Colo., Mar. 10, 1915.

[We think probably the gist of the whole matter is in the last paragraph—the need of a technical patent court, in which expense and delay would be reduced to a minimum. The argument as to its costing the defender of a patent quite as much as it does the infringer seems to take no notice that, with a new device, one is usually an individual, the other a corporation.—EDITOR.]

The A. I. M. E. Meeting

Misther Editor: Well, I was illicted to Tim's minin' society without a dissentin' vote. The Public Service Commission engineer boy watcher bein' called as a witness wan day last week, we cud not do anny work on the subway contract, so Tim an' I attinded the meetin' av the men that folly minin'. There's manny a man follies it with more or less success. Some gets plain tired av the chase, an' others like me an' Tim sits back wance in a while an' studies its habits while we mend our traps an' get the grub ready.

Some folks folly minin' with a rope, aimin' to hog-tie it an' put their own brand on it; while other fellies are content with minin' folly. There's plinty av raw material.

Well, whin we got to the hall Tim luks over a table filled with sheets av paper for the college men to register their affillyayshuns; but some wan had neglected Scranton. So Tim an' I swallyed our disappointment an' tobaccy, rayspictively, an' passed in to the show.

A young felly made some cubist pictures with colored chalk an' put up a good argymint for Montany as a lodgin' place for min'rals. After assignin' rooms on different levels to each kind av min'ral an' gettin' thim all nicely to bed he heaved a sigh av relief an' sat down amid applause an' the hearty approval av mesilf an' his inspirayshun. Whin some av the older wans wint after him like Samsons an' Goliaths, inspirayshun give him a smile av encouragement an' he jumps up like a husky David, lettin' fly a few rocks av the raysarve stock. An' so it went, back an' forth; wan side beltin' the other over the head, figuratively speakin', with a few square miles av granite, an' the other side claimin' a Scotch verdict on copper at great depth but offerin' no alibi.

Whin the referee called it a draw an' adjourned for lunch, wan av the plain minin' engineers sez to another, "The geologists seem to have had the floor." Sez the other, "They have the floor, the hangin' wall, the hoist, the mill an' the compressed-air plant. 'Tis good free-millin' stuff, but they ought to concentrate a little."

Now, Misther Editor, I understand some av the minin' words, but I'm hazy about that rock talk. Was it argymint, was it advertisin', or was it the inishyayshun av the neophyte? Whin I speak my first piece before the organizayshun I'll coax my inspirayshun to go along an' listen; but I'll tell Kathleen to carry a rollin' pin under her *rebosa,* so as to be prepared for anny evenchooalities.

BILL MCGINTY.

Brooklyn, N. Y., Feb. 24, 1915.

Editorials

What Brought About the Collapse in Spelter

When the price for spelter rose above 7c. and started to soar to dizzy heights, a collapse was inevitable. The only question was when it would come. The higher the price went and the more acute the situation became, the sooner was the break to be expected. The advance started from firm ground, statistically, with the exception that the shortage in supply was of spelter, not of ore. There is evidence that the supply of American ore was increasing last December, and of course there was always the huge supply of Broken Hill ore, the blockade of which was the source of all the trouble.

The buying of spelter for consumption is in the main the negotiation of contracts for delivery ordinarily during the ensuing two or three months, the seller thus disposing of the spelter that he expects to make from the ore he takes in. A few smelters sell no spelter until they have made it, but the bulk of the business is done otherwise.

Now, when the market began to advance in January the smelters sold their contracts as usual. The absorption of the small stock of spelter on hand deprived the market of its flywheel and everything became unbalanced. Consumers who were caught short paid large premiums for such prompt metal as could be scraped up, but being apparently of the opinion that they were the victims of an artificial corner they did not quickly enough pay attention to the usual deliveries of the trade.

In the meanwhile the extraordinary prices stimulated the production of ore in all quarters and the smelters taking it in had to sell further and further ahead against it, the supplies becoming more than could be converted into spelter in the ordinary time. The smelters were aware they were riding the whirlwind. Of prompt spelter the market was practically bare, but for April delivery there was considerable available, and of May probably plenty. If spelter for delivery beyond May could be sold in sufficient volume the metal remaining on this side might fetch premiums. The market could have been broken at any time by releasing early deliveries.

Obviously the explosion was bound to come as soon as contraction in consumption and expansion of production intersected so as to strike the spark. The first manifestation of disruption was the common-sense disinclination of anybody to buy the distant futures that smelters were obliged to sell, then the refusal of Europe to buy any more spelter at the prices asked here. Next ore prices sagged, while spelter was still nominally rising. Some ores became unmarketable. Zinc miners who always had wanted a high price experienced the strange sensation of seeing spelter at the acme of price and of being tantalized by the unwillingness of anybody to buy their ore at all. The largest producer of zinc ore was notified that after Mar. 1 only the contractual minimum would be accepted. The producer made arrangements elsewhere for the smelting of its surplus on toll, which immediately added greatly to the probable production of the United States by returning a large inactive and moribund smelting capacity into use. The climax came when a canvass of the galvanizing districts exhibited a greater curtailment of consumption than anybody had previously supposed to be the case. There was immediately an effort to sell spelter for the usual deliveries, but nobody then wanted to buy.

One of the great evils of a period of high price for spelter is the incentive to put money into the building of new smelting works, the equipment of new concentrating mills, the opening of new mines, etc. When the boom has departed the industry finds itself overbuilt and then comes the long, lean time of strenuous competition and narrow margins while the demand is growing up to the productive capacity. The recent events in spelter were different from those of any previous rise, both in cause and in nature, and being so short we probably shall not suffer the consequences so badly as we have previously. Even in its slump spelter has lodged at what is normally a high price, and it may be expected to remain high while the war continues. Once the war is ended there will be available so much smelting capacity that spelter will find its natural level.

Copper Miners' Wages

In several important copper-mining districts wages had to be reduced last August, but in all cases the companies were as considerate of their men as circumstances permitted, in many cases keeping all of their men on part time, and in those cases where dismissal was necessary giving consideration to the men having families. The miners throughout the country faced the situation without a murmur, recognized intelligently that their employers were in no wise to blame for what had happened and were in no way trying to get the better of them; and indeed the men expressed to their employers their appreciation of the consideration with which they were treated. This exhibition of good will on both sides was a bright thing in a gloomy time and will perhaps contribute toward a better mutual understanding in some controversial matters of the day. The sincerity of the copper-mine operators has recently been well demonstrated by the advances in wages that they made voluntarily when the price of copper rose to a figure which enabled them to produce profitably.

The average cost of producing American copper—which is to say about two-thirds of the world's copper—is probably about 10c. per lb. for direct operating expense. The porphyry mines do it for less than that, the Anaconda, Phelps-Dodge and Calumet & Hecla mines experience just about that figure, while there is a considerable production by other mines that runs up to 12 or 13c. per lb. The plant investment for copper production is about 15c. per annual-pound of output. If a producer found a mine and borrowed the capital necessary for its equipment at 6% and set aside 3% for paying it back and 5% for replace-

ment of parts wearing out he would have to get about 12c. per lb. for his copper to come out even. If he bought the mine he would have to get more. At the rate most stockholders have paid they probably ought to get about 14c. in order to get their money back with a reasonable net income. At anything less than 14c. per lb. for copper their dividends begin to be trimmed. At about 12c. they really begin to be out of pocket. This reasoning finds confirmation in the knowledge that all the copper sold during the 10 years ended with 1913 realized an average of 14½ to 14¾c. per lb.

Safety First at Butte

As noted elsewhere in this issue, safety-first work at Butte is proceeding apace. The Anaconda company now requires all foremen and shift bosses to assemble each month to discuss accident prevention. It issues a monthly bulletin on this subject and has erected numerous gates and signs to promote the safety-first idea and keep it before the attention of the miners. More efficient than these, we surmise, is the rigorous action taken by the company for violations of the safety rules. Since the first of the year, a dozen men have been laid off or discharged from Anaconda mines for disobeying the safety rules. This is the quickest, surest and perhaps the only way to get the safety-first idea established on a working basis, as many miners will continue to disregard safety rules unless some penalty be attached. The unions have been as lax in forcing their members to promote the safety of their fellows as they have in promoting individual efficiency. The "open shop" prevailing at Butte, together with general industrial conditions, make the present an excellent time for establishing the safety-first movement on an efficient basis.

The Benzol-Toluol-Gasoline Madness

We have long been accustomed to saying that metallurgical researches and installations go by fashions. Everybody jumps simultaneously into coal-dust firing, or leaching experiments, or into flotation, or long blast furnaces, or grows excited as if playing a game of follow-the-leader.

And so it is that when Dr. Walter O. Snelling comes before the American Institute of Mining Engineers with a new gasoline process, which greatly excited that meeting, according to all veracious reports, probably because most of the excited ones knew very little about the matter, we immediately hear from Dr. Walter F. Rittman that he has discovered a method of producing gasoline, benzol and toluol from crude oil, and immediately afterward Thomas A. Edison likewise blossoms forth with a benzol plant.

Speaking seriously, just what is this all about? We have become accustomed to the Scotch shale-oil distillers producing a light motor spirit, an illuminating oil (paraffin) and a heavy series of oils, which seems to be essentially a cracking of hydrocarbons of heavy molecular weight into those of light. We have seen the Burton process producing over 70% of gasoline from Pennsylvania crude. We have heard of an independent plant where a heavy residue from which all the gasoline had been removed by an ordinary distillation was cracked to produce 45% of gasoline, without, so far as we could see, infringing on the Burton patent. We have seen German references going back to 1906 to a process for producing toluol and benzol from petroleum hydrocarbons. We have seen Doctor Rittman's own thesis, now nearly a year old, in which all essentials of his process seem to be developed and made public. Why all this present excitement?

Therefore, before going on cheering over these processes, can we not stop long enough to have some explanations of wherein the "revolutionary discoveries" differ from what has been known, wherein the discoveries are more at present than interesting laboratory processes, such as is the synthesis of alcohol, using lime, carbon, water, sulphuric acid and an alkali, and whether we should ever have heard of them had not the war cut off the supply of benzol and toluol from Germany; and having heard of them, whether they are not doomed to die aborning by the pressure of those processes already turning out benzol and toluol from coal distillation?

The elimination of the side door from reverberatory matting furnaces is now taking place as the result of feeding and fettling through the roof along the sides of the furnace. When this system of feeding and fettling was applied at the furnaces of the Canadian Copper Co., at Coppercliff, Ont., in 1913 and found to be successful, the side doors were bricked up. When the coal-dust firing, successfully worked out by the Canadian Copper Co., was applied at Anaconda and the furnace there remodeled, no side openings were made as it was felt that the new feeding arrangement would protect the side walls satisfactorily; however, some fettling was found necessary near the skimming end and charge pipes were then installed the entire length of the furnace so as to protect the walls at the skimming end. The newly changed No. 5 furnace at Anaconda is similarly arranged. Though the side doors of the Steptoe furnaces at McGill, Nev., have not actually been eliminated, they no longer have side-door coverings; the openings are piled full of fettling material which is left on the outside sill or shelf of the old door openings; the fettling is still applied with shovel and ladle through the side-door openings, but the general tendency now is undoubtedly toward the elimination of this feature and the making of solid side walls along which the charge and fettling will be dropped.

It will be interesting to figure out the connection between the coal-dust firing or reverberatory copper-smelting furnaces and the flotation process of ore concentration. The dust-fired reverberatory has sounded the death-knell of the blast furnace, and consequently the roasting furnace—of course, some one of the McDougall type—comes into its own again as a preliminary to the smelting furnace. This locks in with the flotation process which produces a sulphide concentrate. The new plans at Anaconda require 28 Wedge furnaces, we understand. The turning of the Anaconda staff from the Evans-Klepetko type of McDougall to the Wedge type is also an innovation in Montana practice that is worthy of notice.

Things in Mexico have gone from bad to worse. Never were they so bad as now. The situation is characterized by one word—Chaos. The questions are asked here: "What are we going to do about the assassination of McManus?" "Why did we occupy Vera Cruz and then with-

draw?" The American government has no program. A Mexican government does not exist. There is not even any strong party in Mexico. Let the rival chieftains carve that unhappy country into palatinates, if they want to. Let Washington aid anybody who is strong and promises to be responsible. But let there be some kind of a policy tending toward restoration of order.

BY THE WAY

The Peruvian Corporation, Ltd., which manages most of the railways of that country and does some mining incidentally, is having trouble with the present Peruvian government in regard to its rights to mine and ship guano. When the Peruvian Corporation was formed to rehabilitate the Peruvian finances, it was granted, among other considerations, the right to mine and ship 2,000,000 tons of guano. It considers that these rights are infringed by the law passed by the last Peruvian congress declaring a preferential right in favor of the national agriculture.

The Surrogate's Court in New York has ordered a reappraisement of the estate of the late Herman A. Frasch, to the original valuation of which reference was recently made in this column. The chief reason for the order was that the appraisement of Union Sulphur stock at $2250 per share was too low. In court is was stated by counsel that the company had paid dividends as high as $4,500,000 in one year; that these profits had far exceeded the value placed on the stock. These statements were not supported by evidence presented in court, but were sufficient to induce the Surrogate to order a new appraisement.

Recently in the *London Financial News* an account was given of an accident which occurred at the City Deep circular shaft and resulted in two white men and several natives being killed. The accident was due to a round of holes being fired by a flash of lightning, and at the time was described as unique in the history of electric blasting on the Rand. Early last month, however, the possibilities of lightning playing down the wire ropes of a shaft were again demonstrated. For a second time a round of holes which had been connected was fired by lightning, with the result that a white miner was severely cut about the head and a native was killed.

A contributor to the *Chino Herald,* telling of experiences during a summer trip into the desert, narrates that while he watched a lizard run across a sunbaked open strip of sand, it disappeared in a puff of vapor. The intense heat of the sand had turned the moisture of its body into steam, the pressure of which rose so high that the little creature was blown into bits so minute that no trace of it was afterward to be found. In backing up his statement, he quotes an old prospector's allegation that in Death Valley, during the heat of the day, water poured from a canteen will not reach the ground, being turned into steam as fast as it leaves the mouth of the canteen. Can you beat it?

At the Last Chance Mine, at Wardner, on Oct. 3, 1914, Leslie Wilson, employed as a miner, while assisting the pipe men in a raise, was standing on a platform of 3-in. planks forming the floor of a drift set that connected with the raise. The connection was completely floored over, except for one plank 12 in. wide and 5 ft. long. When he let go his hold on the small pipe which was being bent he fell through this hole to the level below, and received, among other injuries, a fractured skull, from which he died later. One of the victim's assistants in this work was standing within 6 ft. of him but had his back toward him and did not miss him until he heard a noise down in the raise. It is hard to conceive how a man could fall through such a hole in a normal condition, as it was a snug fit for an ordinary sized man's body.

Robert N. Bell, the state mine inspector of Idaho, always enlivens his annual report with picturesque language. Here is his account of an accident of a kind that is becoming more and more common in mining. It is a foolish accident, but never an amusing one, inasmuch as the fool almost always loses his life.

An experienced timberman, while attempting to blast a hung-up ore chute, was caught in the sliding muck and smothered to death. The chute had an opening from an adjacent manway through which the powder could have been pushed on the end of a stick, but the victim took the chances of going personally up the chute to place the powder, which was about as foolhardy a thing to do as it would be for a man to climb into a loaded cannon of 4-ft. caliber, with an intoxicated force known as "natural gravity" lolling on the trigger.

Another one of our contributors has fallen into the vice of relieving his feelings in verse, the following being his essay:

CALLED BACK

Prospectin'? Well, I reckon you
Might call it that; but what I do
Is look around an' hammer rocks
An' never think of minin' stocks
Nor grubstake deals an' like o' that.
I jest puts on my old slouch hat
An' prowls around the mountains here
An' ketch some trout or kill a deer.

Then p'rhaps some day I'll find a vein,
Or strike some little creek again
With gravel rich enough to dig
By hand, or fixed so I can rig
A little boom-gate with a dam;
Then I can stretch myself back ca'm,
An' smoke my pipe where I can see
Old Mother Nature work for me.

That's how I made my first big stake;
An' every Saturday I'd take
The riffle poles from water cold
An' harvest crop of yellow gold.
Then all the week the pond would fill
Up night and day from mountains rill
Until, all with a rush, she poured
A torrent forth to bare the hoard.

Gone busted? Yes, I have done that
At times; an' tossed a fine silk hat
Up with the crowd at races, too;
An' opened wine for birds that flew
As high as any you have seen.
(I reckon you know what I mean.)
But, still, I weren't what you'd call **wild**;
An' nowadays I'm pretty mild.

Yes, mild and meek is what I am;
An' down home I don't dare say **damn,**
For fear a certain toddlin' mite
Will lisp out "Gran'pa, 'tisn't right
To say such awful naughty words."——*
I swan. — She twitters like the birds.
Say, stranger, come to town with me.
My motor's down behind that tree.

*Business of wiping sweat from brow with faded bandanna.

Gold Deposits in Alabama

There are a number of paying deposits of gold in Alabama which will probably be worked profitably in the future. In fact more than $500,000 has been credited to the state by the U. S. Mint, and it can be safely estimated that the yield was more than double this amount, for a great deal of gold was mined which was never reported to the Mint, according to R. C. Barnard, writing in the *Birmingham News*. This was because, until recent years, no systematic means were employed in gathering statistics, and a correct estimate would have been absolutely impossible.

The gold was obtained principally from placer mines, which were worked in a crude and extravagant manner. It is usually true that the placer deposits of any gold-mining country, while the first to be mined, are of secondary importance, and soon worked out.

The lode ores of Alabama are not refractory, and can be worked by well known processes which deliver high percentage extractions. They occur in the Algonkian formation, which in Alabama is composed principally of argillaceous, gneissic and micaceous schists, traversed by belts and dikes of granite, diabase, diorite, and various other granitic rocks. The gold is found in quartz veins, placer deposits, and in some of the pyritic rocks. Quartz veins occur in fissures or openings in the country rock, and have been variously classified. Owing to their tendency to assume a lenticular form they have been often called stringer leads. Often the smaller stringers are disconnected, but can almost always be found again in the foot or hanging wall. The veins are of imbricating character and usually show much shingling.

The auriferous rock of these veins consists of quartz of various kinds and colors, varying from pure white to brown or a bluish black. Gold-bearing sulphides are often found in the quartz, and near the surface, where the sulphides have become oxidized, the gold is free and amenable to amalgamation. At depth, where the pyrites are unaltered, the ore, although equally auriferous, is refractory and yields only a part of its value to the plates of the ordinary stamp mill. This problem can be solved by giving the pulp, after it passes over the plate, a secondary treatment by the cyanide process, to which the ores have been shown to be amenable.

The deposits should be explored below the line of oxidation, or to where the solid rock is to be found in place, in the hope that gold will be found to permeate the whole structure, as it does in many large, paying, low-grade mines. Under ordinary conditions if an average value of but $2 or $3 per ton could be maintained in these large orebodies the mine would be assured of success. A number of these deposits have been worked in Alabama in the past, but only so long as the decomposed rock could be sluiced, or the free gold saved with quicksilver.

In some localities these large ore zones can be traced by a system of pits, which today are nearly filled with rubbish and cavings. These pits were dug many years ago, before the establishment of an authoritative record, and in many places are quite extensive, much larger than would have been required in mere prospecting. But of course at that time it was utterly impossible to save anything but the placer gold; therefore it followed that as soon as solid rock was reached, although auriferous, operations were necessarily suspended.

Many of the gold ores in Alabama are particularly adapted to the cyanide process, and if they are given a fair trial by competent and experienced men I firmly believe there will result the redemption of many old mines and the opening of many new ones.

Lead Imports and Exports

The imports of lead into the United States in 1914, as compared with previous years, showed a remarkable decrease, which was chiefly in the receipts from Mexico. These imports are almost entirely of metal in ore and base bullion, to be refined here. On the other hand, the exports for the year showed an increase of 80.1%, owing to the large shipments of domestic lead, which compare with a negligible quantity in 1913. In 1914 these were 73% of the total exports. The extraordinary demand in Europe, coupled with a decrease in home consumption, easily accounts for these changes. The exports were mainly in the second half of the year, as shown in the accompanying table. Those reported in the first half were chiefly in May and June, as follows:

IMPORTS AND EXPORTS OF LEAD, 1914
(In Pounds)

		Exports		
	Imports	Domestic	Foreign	Total
First half year.	25,628,703	40,323,662	17,666,875	57,990,537
July	1,523,614	21,787,779	2,237,414	24,025,193
August	4,117,601	10,657,551	.....	10,657,551
September	3,841,648	5,585,246	1,845,692	7,430,938
October	6,707,267	15,659,012	5,041,979	20,700,991
November	6,265,514	16,833,879	10,593,265	27,427,144
December	8,569,709	6,281,771	5,703,050	11,934,821
Second half ..	31,025,353	76,805,238	25,421,400	102,226,63[illegible]
Apparent correction	22,747	315,000	2,100	317,100
Totals for 1914.	56,676,803	117,443,900	43,090,375	160,534,275
Totals for 1913.	114,293,966	.....	89,087,111	89,087,111

The line of "apparent corrections" in the table expresses a discrepancy of the monthly and yearly statements, which seems to be due to small corrections made in the monthly reports after their issue. In 1913 no exports of domestic lead were reported in quantities, though there were exports of "manufactures of lead" valued at $738,135 during the year.

Route of Alaskan Railway

President Wilson has decided upon the route for the Alaskan Railway, the building of which is to begin this spring, according to reports from Washington dated Mar. 16, but an announcement will await the outcome of negotiations with one of the two existing lines which the Government may buy. Secretary Lane said before the Cabinet meeting, Mar. 16, that the announcement might be delayed several weeks and until after his return from San Francisco.

Juneau Harbor

The photograph on page 456 of the JOURNAL of Mar. 6, 1915, is erroneously described, due to a mistake in the caption furnished by the photographer. It is not a view of the harbor of Juneau, but of Wrangell harbor, Alaska.

Radium, Uranium and Vanadium ore production in 1914 in the United States amounted to 4300 tons of dry ore, according to the U. S. Geological Survey, carrying 87 tons of uranium oxide and 22.4 grams of metallic radium. The total amount of vanadium in the carnotite and other ores mined was about 432 tons. Two companies produced radium during the year, the Standard Chemical and the Radium Co. of America, and Dr. W. A. Schlesinger opened a radium-refining laboratory.

PERSONALS

John T. Fuller is president of the Fuller-Shepherd Mining Co., operating at Rush, Marion County, Arkansas.

Charles E. Dyer, of Denver, has moved to Ray, Ariz., to join the engineering staff of the Ray Consolidated company.

D. C. Jackling and F. S. Janney will start soon on a trip to inspect the property of the Alaska Gold Mines Co. in Alaska.

Thomas M. Skinner, Jr., whose former address was Box 41, Red Cliff, Colo., is now with the Inyo Development Co., of Keeler, California.

H. L. Heath has resigned his position with the Smuggler Union Mining Co. at Smuggler, Colo., and is now with the Crown Point Mining Co. at Gold Hill, Nevada.

Leo Von Rosenberg recently left the Ray district, Arizona, and has gone to the Cripple Creek district in Colorado. He will return to New York about the end of March.

A. A. Hassan has his temporary address with the Tennessee Copper Co. at Copperhill, Tenn. He is examining manganese ore deposits in Tennessee, West Virginia and Virginia.

Dr. H. T. Kalmus, who for the last five years has been conducting experiments in metallurgy at the School of Mines, Queen's University, Kingston, Ont., has completed his work there and returned to Boston.

Frank H. Sistermans has returned from a professional trip to the northwestern part of Nicaragua, Central America, after an absence of over two months, and is again with the Mines Management Co., at 60 Broadway, New York.

Charles Cantley, former assistant manager of the Nova Scotia Steel & Coal Co., and son of Thomas Cantley, the general manager, has been appointed quartermaster-general with the Canadian expeditionary force in France.

George O'Brien, instructor in training at the Provincial Government mine-rescue station at Fernie, Crow's Nest Pass, B. C., has been appointed a district inspector of mines in British Columbia to succeed the late Evan Evans.

J. L. Nichols, of the Pittsburgh Crucible Steel Co., has been appointed assistant superintendent and assistant metallurgist of the open hearth department at Midland, Penn. Mr. Nichols has had five years' experience making different kinds of steels.

Frederick Brulé, who was superintendent of the surface department at the Washoe reduction works at Anaconda, some years ago, has recently been appointed superintendent of the surface department at the Boston & Montana reduction works.

T. J. Vaughan-Rhys, for several years connected with mining in the Portland Canal district of British Columbia, is now developing a mine situated near Rocher Deboule Mountain, a few miles from New Hazelton, in the Skeena district of that province.

M. E. Appelbaum has moved his offices from No. 55 Liberty Street to the United States Rubber Co. building at No. 1790 Broadway, corner of 58th Street, New York. The location of large copper brokerage offices so far up town in New York is a decided novelty.

Dr. August Ledoux, who was professor of mineralogy in the University of Brussels before the war, and was wounded at the battle of Liege, has received a special appointment as lecturer on the staff of the University of Toronto and will devote much of his time to research work.

T. A. Rickard is on his way from London to San Francisco, where he intends to make his permanent residence, taking entire editorial charge of the "Mining Press." H. Foster Bain for some years past editor of the "Press" has gone to London to take charge of the "Mining Magazine."

Richard Wareham, a retiring carpenter, residing in Hancock, Mich., helped to frame the timbers for the first stamp mill erected by the Calumet & Hecla Co. at Lake Linden in 1867. He has the plans of the original mill, drawn by the late Alexander Agassiz in his own hand, on ordinary brown wrapping paper, at Calumet. Mill was 83x50 ft. built by a contractor named Palmer.

H. G. Wright, formerly chief draftsman at the Washoe reduction works, has been appointed superintendent of construction and will have general charge of the new work that is to be done at the converter and reverberatory-smelting plants at Anaconda. J. B. Johnson, formerly assistant, has been appointed chief draftsman, and S. Bishop has been made assistant chief draftsman. The Anaconda Copper Mining Co. is now employing about 75 draftsmen at the Washoe reduction works, and about 20 at the Boston & Montana reduction works. This force has been organized for the purpose of drawing up plans for the extensions to be made at these works and is said to be the largest engineering force ever gathered together in the Rocky Mountain district.

Roy O. Olivier has been appointed superintendent of the Franklin stamp mill, in the Michigan copper country, in place of Edward Wearne, deceased. Mr. Olivier is a graduate of the Michigan College of Mines. Upon graduation he went to the Franklin, working first as trammer, then miner, then lander in the shaft and then engineer, later as assayer and assistant to the superintendent of the mill.

OBITUARY

Carl Benjamin Franc, a mining engineer, died of typhoid pneumonia on Monday at Gold Road, Ariz., where he had been superintending mining operations for the past six years. Mr. Franc was born in Brooklyn 31 years ago and was a graduate of the Columbia School of Mines.

William H. Cole, of Duluth, Minn., head of the Cole & McDonald Exploration Co., died on March 9, at Pasadena, Calif., where he went to spend the winter. The funeral took place in Duluth on Monday, March 15. William H. Cole was one of the prominent mining figures in the Lake Superior field and an authority on mining exploration work. He was directly responsible for the opening of a number of the large iron properties on the Mesabi and other Minnesota ranges. He was interested in the Whiteside, Agnew, Buffalo & Susquehanna and other mines. He was also the president of the American Exchange National bank, of Duluth, one of the strongest financial institutions in that city. Mr. Cole was born in Ontonagon, Mich., 58 years ago. At an early age he became interested in diamond drill work, and went to the Marquette range in 1879, where he assisted in putting down the first drill holes on that range. He was at that time connected with the old Bullock company, which was later taken over by the Sullivan Machinery Co. In 1885 he went to Tower, Minn., on the Vermilion range, where he assumed charge of the exploration work for the old Minnesota Iron Co. He continued with that concern until 1892, when he resigned to go into business as an independent diamond drill contractor. He formed the Cole & McDonald Co., which was later changed to the Cole & McDonald Exploration Co. At the time of his death he had retired from business to a large extent.

After a continuous search of over three months, through all parts of rough and almost impassable mountains, the body of Captain Michael Cooney, noted mine operator and member of the Board of Regents of the New Mexico School of Mines, was found in an arroyo near Turkey Creek 50 miles north of Silver City, N. M., in the Mogollon range. The remains were decomposed but were packed to an automobile road three miles where they were removed to Silver City and later shipped to the old home, Socorro, N. M., where interment took place Feb. 21. Captain Cooney left his home at Socorro on Oct. 26 with his two pack-ponies, "Tom" and "Jerry," for a prospecting trip in the country surrounding his former haunts. He was 76 years old, but was strong and hearty and went on his trip alone. From the day he left nothing had been heard of him. Many searching parties had gone into the mountains but each effort was futile as severe snow storms drove them back. Robert Lewis, the Socorro County cattle inspector and several associates, found the body on Feb. 15. Death was doubtless due to exposure, and lack of food and water. One of the horses had met death by falling over a steep cliff, but the other was found wandering not far from the corpse. Captain Cooney's saddle was found and tied at the horn was a pocket diary in a cloth bag. The diary contains a pathetic account of the prospector's adventures from the day he left his home until Nov. 15. It depicts the suffering and endurance of the aged man. Throughout the pioneer keeps in constant thought his two horses. At times he writes of smelling cooking meat and hearing the ringing of bells. Toward Nov. 12 he found water but was overcome in the storms that followed. His last entry was made on Nov. 15 and reads: "Let in a little sun and feels better." The writing was firm until the last. Captain M. Cooney, was a brother of the late J. C. Cooney the noted scout, Indian fighter and prospector, who discovered the gold and silver veins of the Mogollon mountains and who was killed by Indians while operating the mines at the camp near Mogollon bearing the family name "Cooney." The late Captain M. Cooney came to New Mexico following the death of his brother in 1880 and took up the mining work where his brother had stopped. He was at various times, mayor of the town of Socorro, N. M.,

county treasurer and member of the state legislature. He is survived by a wife and one son. The house of representatives at Santa Fé adjourned out of respect to his memory. This closes another chapter in the passing of the pioneers of New Mexico as practically all the early prospectors and developers in the Mogollon mountains are gone. In Captain Cooney the state loses one of its best citizens and mining men.

SOCIETIES

Engineers' Club, of Virginia—A meeting of the club was held March 11 in the public library at Virginia, Minn. A. A. Beville read a paper, entitled "The Engineer and His Work."

Colorado School of Mines Scientific Society—At a meeting held at Golden, Colo., Feb. 26, the following officers were elected. V. D. Howbert, pres.; C. E. Carstens, vice-pres.; F. E. Briber, corresponding secretary.

American Chemical Society—The fiftieth meeting will be held at New Orleans, Mar. 31 to Apr. 3. The headquarters of the society will be at the Grunewald Hotel; meetings will be held there and at Tulane University. At the close of the meeting there will be an excursion to the salt mines on Avery's Island.

Society of Chemical Industry—A regular meeting was to be held in Rumford Hall, New York, March 19. After the annual election the following papers were read: "The Causes of the Opalescence of Glass," by J. G. Smull; "Some Interesting Phases of Glass Making" and "The Use of Barium Compounds in Glass," by Alexander Silverman.

American Institute of Chemical Engineers—The seventh semi-annual meeting of the Institute will be held in San Francisco, Calif., Aug. 25 to 28. An itinerary is being arranged so that the interesting natural scenery of the West may be seen and also some of the more important mining operations as well as the typical chemical industries of California.

Australasian Institute of Mining Engineers—At the annual meeting at Melbourne, Jan. 29, the following officers were elected: President, Robert Sticht, Tasmania; vice-president James Horsburgh, Queensland. Council, E. G. Banks, New Zealand; W. H. Corbould, John W. Moule, Queensland; C. F. Courtney, New South Wales; H. Lipson Hancock, South Australia; H. Herman, Ernest W. Skeats, Victoria.

Montana Society of Engineers will hold its annual meeting in Butte, April 8-10. A committee consisting of Reno H. Sales, president; Clinton H. Moore, secretary, and Messrs. B. H. Dunshee, Sam Barker, Jr., and H. C. Bacorn, has been named to arrange the program and all the details for the meeting. A number of important subjects are scheduled to be covered by papers from leading members. Electrical engineering as applied to mining, railroads and to light and power will be discussed in detail in view of the expected electrification of many of the railroads and the work already accomplished by the Anaconda road.

American Institute of Mining Engineers—The Utah section met at the Alta Club, Salt Lake City, Feb. 25. R. C. Gemmell was toast master at the dinner which was followed by a discussion of the program for the year which will include an excursion to Tintic in July, at which time a paper on the "Economic Geology of the Tintic District" will be given by G. W. Crane and a paper on the "Separation of Zinc," by D. A. Lyon; a joint meeting, in October, with the Utah Society of Engineers at which papers will be presented on "Flotation," by J. M. Callow, and on "Underground Mining as employed at the Utah Copper," by a member of the company's staff. At a joint meeting of these two societies Feb. 19, papers on "Recent Improvements in Metallurgical Practice," by S. S. Arentz and on "Some Improvements in Mining," by R. S. Lewis were presented.

Teknik Club of Denver—Under the auspices of this club a series of lectures is being given by Dr. Lucien I. Blake on the general subject of "Cosmic Physics." Although these lectures are of high scientific import, they are given in non-technical language and are illustrated by excellent experiments and lantern effects. In his second lecture, March 8, Dr. Blake, with the assistance of Prof. L. F. Miller of the physics department of the Colorado School of Mines, projected upon the screen actual direct spectra showing lines produced by various elements and also a few spectra showing the absorption effects of incandescent vapors of the same elements. At the regular monthly dinner of the club, March 9, E. J. Dittus, instructor in metallurgy at the School of Mines, Golden, delivered a paper on "High-Temperature Measurements with Thermoelectrical and Optical Pyrometers."

INDUSTRIAL NEWS

The Goldfield mining-district map will be issued by Wilkinson, Currie & Anigo hereafter, as that firm has purchased the 1907 copyright of Elmer J. Chute. The map will be revised to date and will sell for $5 for the wall size and $2.50 for the pocket edition.

E. M. Breed, who for the last eight years has been district manager of the Canadian Allis-Chalmers, Ltd., with headquarters at Vancouver, has been appointed district manager of the Pelton Water Wheel Co. He will continue to make his headquarters at Vancouver.

Steam turbine drives for rolling mills are discussed in an illustrated pamphlet distributed by the DeLaval Steam Turbine Co., of Trenton, N. J., which recently installed the geared steam turbine driving an 18-in. three-high roughing mill at the plant of the Carpenter Steel Co., Reading, Penn.

Catalogs of railway equipment, mining machinery, etc., will be filed by the Instituto de Ingenieros de Chile, Santiago, Chile, and the Departmento Technico, Sociedad National de Mineria, Ministerio de Industrias y Obras Públicas, Santiago, Chile, where they will be accessible to the public, according to Commercial Attaché V. L. Havens of Santiago, Chile.

The Sorge-Cochrane hot-process system of softening boiler feed water is described in a 20-page pamphlet lately issued by the Harrison Safety Boiler Works, 3133 N. 17th St., Philadelphia. This process is based upon the fact that chemical reactions are more rapid and complete in hot than in cold water and the precipitates less soluble and coarser, so that they settle more rapidly.

T. A. Bennett, who for the past five years has had charge of the conveyor and elevator-belt sales of the B. F. Goodrich Co., Akron, Ohio, is severing his connection with the Goodrich company on Mar. 1, to become the Assistant to the General Sales Manager of the New Jersey Zinc Co., with offices in New York. Mr. Bennett will be succeeded by J. D. Mooney, formerly special mining representative for the Goodrich company.

The Stark Rolling Mill Co., of Canton, Ohio, announces the appointment of the Dearborn Steel & Iron Co. as its selling agent in Chicago, northern Illinois and Wisconsin. The Dearborn Steel & Iron Co. is a new company, composed of H. C. Perrine and E. L. Lyon, both formerly with Jos. T. Ryerson & Son, and Mr. Perrine more recently with the Fred Gardner Co. The Dearborn company's office will be in the Peoples Gas Building.

The Colorado Iron Works Co. announces the establishment of a down-town office in Denver for the accommodation of its many customers and friends who may find it inconvenient to visit the main office at the works. Suitable quarters have been obtained in the Ideal Building, corner 17th and Champa St. The office is in charge of Hugh B. Lowden, secretary of the company, and Randall P. Akins, sales manager, will make it his headquarters when in the city.

Notwithstanding the general business depression during last fall and early winter, the Broderick & Bascom Rope Co., manufacturer of Yellow Strand Power steel wire rope, arranged matters so that every man and boy on its big payrolls had work. Last spring its big St. Louis plant was running full force, at least 85% of its full time. Later in the year it operated three-fourths time, but kept the entire day and night force. Finally, during part of October and all of November, it ran one-half time, still keeping all the men employed. During December, that the men might have some extra money for Christmas, it ran the entire St. Louis plant full time, day and night, even though that meant piling up large stocks of wire rope. This resulted in no little expense, for increasing one's stock several million pounds is no small matter. Now, with improving conditions, the matter of employment, time, etc., is working itself out naturally.

TRADE CATALOGS

The Atlas Car & Mfg. Co., Cleveland, Ohio. Bulletin No. 1175. Storage Battery Locomotives, Cranes and Cars. 32 pp., illus., 6x9 inches.

Chain Belt Co., Milwaukee, Wis. General Catalog No. 56. Elevating, Conveying and Concrete Machinery. 304 pp., illus., 6x9 inches.

The C. C. Fonts Co., Middletown, Ohio. Catalog. The Fonts Unit System Steel Shelving and Bins. 16 pp., illus., 6x9 inches.

Editorial Correspondence

SAN FRANCISCO—Mar. 10

Mountain Copper Smeltery at Martinez on San Francisco Bay resumed operation on Mar. 1 with the blowing in of No. 3 furnace. This furnace is about one-half the capacity of the full plant. The present demand for copper is sufficient also to warrant the completion of the concentrating plant at Keswick, Shasta County, and resume mining at Iron Mountain in the same county. During the enforced idleness at the mines the company allowed married men to retain the company cottages free of rent and reduced prices and extended credit at the company store. The result is that now the company is ready to resume mining its former men are at hand. This resumption has put about 200 men on the pay rolls.

The Mammoth Copper Co. is again purged of contempt in the U. S. District Court at San Francisco. Judge Van Fleet on Mar. 9 denied the petition of McCoy Fitzgerald and other Shasta County farmers filed last November. It was the old story of fumes affecting the crops and the lands of the farmers whose agricultural prosperity has been directly due to the mining and smelting of copper ores. Not since the Bully Hill and the Balaklala smelteries quit treating copper ores and the Mammoth installed a baghouse have the smelting companies contributed directly to the support of the farmers. Every year since the first ton of ore was smelted about 20 years ago, the horticultural and agricultural crops in Shasta County have increased, but almost every year the farmers have complained that their crops were being destroyed. By and by the farmers will get tired of paying fees to attorneys and wake up to the fact that the courts cannot be fooled. The number of complaining farmers in Shasta County is gradually diminishing, it is encouraging to note.

DENVER—Mar. 11

Dredging Along the Upper Arkansas River channel is contemplated by the Derry Mining & Land Co., a new corporation. The company owns the Derry ranch, southwest of Malta station on the Denver & Rio Grande Ry., in the Leadville district, directly below the mouth of California gulch, famous for its pioneer placering.

Annual Meeting of the El Paso Consolidated, held in the main office, Denver, Mar. 8, required three days to elect directors. So many factions had clamored for proxies owing to contests for offices that there were many instances of duplicate proxies and two days were consumed in arriving at figures on the voting representation. Plain-clothes detectives were on hand but their services as peace-keepers did not become necessary. Stockholders went on record endorsing Burris' attempted merger of Cripple Creek properties, claiming that his failure was due wholly to the financial depression brought about by the European war, and stating that all his expenditures in the effort had been duly authorized at each of the two previous annual meetings.

Prevention of Highgrading is the object of House Bill 326 introduced during present session of Colorado Legislature. It aims to accomplish this by placing an annual license tax of $100 on every person, firm, association and corporation carrying on the "business of milling, sampling, reducing, purchasing or receiving for sale ores, concentrates or amalgams bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens." To engage in such business, application for a license must be made to the secretary of state and must be accompanied by a $5000 bond with sufficient sureties. Further, every such purchasing concern will be required to keep and preserve a record of every receipt of any of the substances enumerated, together with name of party on whose behalf material is delivered, name of party delivering, date of delivery, occupation of party delivering, weight or amount and short description of material, and the name and location of property whence it originated. Violations are to be punishable by fines ranging from $100 to $1000 or by imprisonment for periods varying from 30 days to six months.

BUTTE—Mar. 11

The High Price of Spelter has caused the Butte & Superior company, the Elm Orlu and Timber Butte Milling companies to operate their mines and mills at the limit of their capacities. At the Elm Orlu 837 tons were hoisted per day recently but this output cannot be maintained as the Timber Butte mill treating this ore at present has a capacity of only 450 tons per day. In the mean time the engineers of this company are carrying on experiments with the more refractory zinc ores and as soon as the results, which have been highly satisfactory, have been reduced to a profitable commercial basis, the Timber Butte company contemplates increasing the capacity of its mill which will enable it to treat besides the Elm Orlu ore, the product of other zinc mines in the district.

At the Butte & Superior, the month of February was a record breaker. The output of the Black Rock mine was the largest in the company's history. The payroll and the number of men employed as well as the returns in zinc from the output will be the greatest in the history of the mine. The amount of ore mined and milled was 39,310 tons, more by 2000 tons than in any previous month. The total recovery of concentrates exceeded 12,000 tons. The number of pounds of zinc realized from this will exceed 13,000,000 lb. During the month 1200 men were employed with a payroll of more than $125,000.

SEATTLE—Mar. 10

At Fish Creek, on Yukon River, some distance above the mouth of the Tanana River, a tract 1½ miles square has been withdrawn by a recent executive order for possible government-railway townsite purposes. Withdrawal order also included tract at Fort Gibbon military reservation, at the junction of the Tanana with the Yukon. The fact that the banks of the Yukon are high at Fish Creek and that the river is comparatively narrow indicates that the government railway may cross the Yukon at this point.

On the Creeks of the Fairbanks Section much activity is reported by miners who have made a tour of the district. Owners of claims, which are worked only during the summer months are making preparations for the coming operations and are having thousands of cords of wood delivered on their ground for the season's fuel. Many new paystreaks have been discovered during the winter which are expected to increase the output of the district next summer. The richest finds of the season have been reported from Ester, Vault and Wolf Creeks.

Port Wells District is one of the subjects of favorable report by several miners who have recently returned from there. J. W. Spaulding who formerly had charge of the Sheep Creek for the Alaska-Gastineau is now developing a property in this district and states that much development work will be done this summer. Two ledges have been exposed, one upon which a tunnel is being driven from the beach shows an average of over 6 ft., assaying more than $20 per ton. A crew is now getting out piles, putting in a wharf and erecting mine buildings while the tunnel crew is driving on the orebody.

Winter Prospecting on Chisana has been productive of good results according to those who have just returned from the district for supplies. Good pay was recently found on Wilson creek, one of the main streams of the camp. This find is considered most important as Wilson creek heretofore has shown no pay and by many was considered barren. Since the fall of snow recently, which has made the sledding good, the Chisana has been a busy camp. Many of the prospectors have been engaged in sledding wood to the claims, and are now sinking. Numerous prospect holes have been sunk on Alder, Bryan and Big Eldorado creeks, with the result that good pay has been uncovered at several points on the various benches. These finds have done much to hearten the prospectors and miners who are now predicting a prosperous season for the camp with a production of practically double that of last year.

GOLDFIELD—Mar. 10

The Goldfield Litigation besides arousing a great deal of interest has cast some gloom over the camp which was relieved only partially by statements issued by the various interests. Most important, is an agreement between the Jumbo Extension and the Booth officials which will permit operation of the Jumbo Extension mine to continue during the pendency of the apex litigation. This agreement requires only the approval of the Court, when normal operations will be immediately resumed. The agreement, besides permitting underground work, allows the defendant company to withdraw

funds, tied up by the restraining order, for settlement of indebtedness incurred prior to the order, for professional advice, geological and otherwise, for protection of its interests in litigation, and not over $10,000 monthly for underground operations. It is further agreed that at all reasonable times the engineers, experts, and assistants of both companies shall have the right to enter either property for securing such data as may be deemed necessary by them for use in the litigation.

As a Result of the Restraining Order the disbursement of the Jumbo dividend, for which checks were all ready made out, was prevented.

An Official of the Jumbo Extension states that a difference arose in the directorate of the Merger Mines company over its sale of the Velvet claim to the former company. A receiver was asked for by minority stockholders of the Merger and at a hearing a compromise was suggested by a consolidation of the Merger, Jumbo Ex., Booth and Kewanas. On this occasion the Booth for the first time advanced its Jumbo Ex. apex claim. The Jumbo Ex. refused to join the conference claiming a perfect title to the Velvet and therefore having nothing to compromise and seeing no advantage in a consolidation. The Jumbo Ex. claims that failing in the consolidation scheme, the filing of an apex suit was simply an adroit change of tactics.

The Secretary of the Goldfield Consolidated is quoted as saying, in refutation of a rumor that Booth would bring an apex suit against the Consolidated, that when it became apparent from underground developments that the Booth might have the apex of the vein from which much valuable ore had been mined in the Laguna, Miss Jessie and other Consolidated claims, an agreement between the Booth and Consolidated was consummated, whereby for valuable considerations, release for liability for past ore extractions was secured and vertical boundaries were agreed to, thus preventing any future apex troubles in this connection.

WALLACE—Mar. 8

In the Case of the Ontario Mining Co. against the Stewart Mining Co. a decision of the district court gives the Ontario a verdict for $46,084.91 and interest since July 1, 1914, amounting to $2150.53, making a total for the plaintiff of $48,245.44.

The court holds in its findings that the trespass existed from Jan. 20, to Sept. 2, 1914, and estimates the amount of ore taken out as about 70,000 cu.ft., ten cubic feet to equal a ton. It decided that the trespass was partly innocent and partly willful and divided the ore removed into two groups. The willful trespass was set at 46,662.75 cu.ft., while 24,030 cu.ft. was taken innocently.

SILVERTON—Mar. 11

The North Star Mine on Sultan Mountain which has produced several million dollars' worth of sulphide ore carrying gold and silver and upon which is a large plant of mine and reduction machinery, was sold Feb. 26 to J. H. Slattery of Silverton for $12,000, at sheriff's sale.

The Champion Mine near Silverton is being examined by Z. W. Waybright, a New York attorney, and D. R. Thomas, formerly of Butte, for the American Flotation Co., it is reported. They are also said to have under consideration the Ben Butler property and several others in the Mineral Point country above Animas Forks 13 miles north of Silverton. Machinery is said to have been ordered for the Ben Butler and it is expected that operations will commence the latter part of March.

DEADWOOD—Mar. 11

Possibilities of Low-Grade Mining are exemplified by achievements of the Wasp No. 2 mine, at Flatiron, S. D. This property is equipped with a dry crushing, cyanide leaching plant of 15,000 tons monthly capacity in which a saving of 75 to 80% of the gold is made at a cost of about 60c. per ton. Ore comes from opencut workings, from which 10 to 20 ft. of overburden is stripped with a steam shovel. The total cost of mining, including delivery of ore to the mill over a 1500-ft. skipway, is 60 to 70c. per ton. Total costs of operation are $1.25 to $1.30 per ton. In 1910 a new mill was constructed to replace a plant destroyed by fire. It was placed in commission in December, of that year, and since then, to the end of 1914, has treated 623,520 tons of ore recovering $1,083,646, an average yield of $1.738 per ton.

CUYUNA RANGE—Mar. 13

Operations for 1915 are already under way and the outlook is for a better year than last. Armour No. 2 and Kennedy have been steadily stockpiling all winter. Crews are at work preparing the Thompson, Rowe and Pennington pits for operation, the two former to begin in March. Stripping operations are to be conducted on the Armour No. 1, Hill Crest, Cuyuna Iron & Manganese Ore, and Cuyuna-Sultana, the latter's expected product being high manganese iron ore. At present the Range's high-manganese producers are all idle; however, the Iron Mountain shaft at Manganese is being equipped with a new surface plant, its former plant being crude.

On the south range the Wilcox is hoisting such ore as it encounters in opening, about 50 tons daily. The company's entire output is contracted to Canadian consumers and it will be one of the range's substantial operations. At Brainerd the Brainerd-Cuyuna shaft has been anchored in ledge, and two shifts are working. The Adams and Barrows shafts continue idle although drilling on the latter property has recently shown a considerable tonnage of ore said to be superior to any heretofore encountered on the South Range.

MESABI RANGE—Mar. 11

Spring Activity exists at a number of places on the range, although no operator seems to be making strenuous efforts for early production. Very little stockpiling has taken place during the past winter.

HOUGHTON—Mar. 10

No Report on the Michigan Copper Strike will be made by the House Committee, which made an exhaustive inquiry during the past summer. The Chairman of the Committee said that the end of the strike led the Committee not to make a report. A discussion of strike conditions now, it is thought, would only cause recrimination and disturb conditions. Agents of the Department of Labor published a report several months ago.

The Michigan College of Mines is in receipt of some superb mineralogical specimens from the celebrated Shattuck cave, near Bisbee, Arizona. The specimens were shipped to the college at the expense of the Shattuck-Arizona Copper Co. through the courtesy of the superintendent Arthur Houle, brother of Professor A. J. Houle of the department of metallurgy and ore dressing of the college. The specimens consist of pure white growths of calcite and aragonite crystals and are typical of the walls of this wonderful cave.

LORDSBURG—Mar. 10

At Tyrone in the Burro Mountains a new townsite is being laid out, up Mangas draw from the "Pines," by the Burro Mountain Copper Co., and a grade laid out from the site to the railroad. It is understood the company offices and stores will be located here. Work is progressing rapidly at the mill site and steel construction work is under way. A power transmission line was built from the mines to the mill during February. Experimental work has ceased and the experimental plant has been dismantled. There are no other active operations in the Burros at the present time except those of the Phelps-Dodge company.

EDMONTON—Mar. 9

Prospecting Parties from British Columbia for months past have been examining the country near Fond Du Lac on the northeast arm of Lake Athabasca, and are reported to have made an important discovery of high-grade silver ore. The point of embarkation is Athabasca Landing, but the discovery is in Saskatchewan, to reach which now dog trains will be necessary from Fort McMurray. The break up of the ice is usual between the middle and end of April on the Athabasca River and slightly later farther north on the lakes. This has been a mild season and the several parties now hurriedly outfitting to go to the new strike will likely be able to get an early start.

TORONTO—Mar. 13

The Heavy Insurance Rates on silver shipments to England are likely to prove practically prohibitive to consignments to London from the Cobalt camp and will probably have the effect of diverting bullion exports to the New York market, or inducing the stronger companies to store their output until conditions improve.

A Shortage of Power in Porcupine and Cobalt has been caused by the dry season which prevailed in Northern Ontario last summer and fall. The Northern Ontario Power Co. has given notice to its customers that commencing with March only half the regular quantity of power will be available, and it is expected that this condition of affairs will continue until the spring break up occurs. While the shortage is largely due to the low water, the increased demands of the Hollinger and the Dome are also partly responsible. These two companies, however, have special arrangements with the power company and are not affected to the same extent as the other mines because the Hollinger people built the Sandy Falls plant for their own use and subsequently turned it into the Power Co. and the Dome interests were associated with the Waweatin plant and as a consequence secured an ample supply of power. The production of the camp will probably show decreases for the next few months.

The Mining News

ALABAMA

CENTRAL COAL & IRON CO. (Holt) — Fire caused $10,000 damage at furnaces. Engine room destroyed, blowing engine damaged and waterworks and electric-light system completely out of commission. Furnace will be shut down for 60 days at least.

ALASKA

McWORTER SILVER MINE on Glacier Creek, upper Stewart River district, has vein 4 ft. wide at bottom of 141-ft. shaft. Picked ore shipped to Trail smeltery returned $600 per ton. It is planned to make 1000-ton shipment when navigation opens. Six hundred tons already hauled 30 miles to steamboat landing at Mayo.

DENVER ASSOCIATION (Fairbanks)—Archie McIntosh and others have leased this placer claim and will install a hydraulic plant this spring.

ALASKA MEXICAN (Treadwell)—Operated 120 stamps 30.3 days in January crushing 18,865 tons ore, gross value $41,821, yield $2.21 per ton. Net operating profit $18,209.

ALASKA UNITED (Treadwell)—Operated 120-stamp mill 30.3 days and one 120-stamp mill 28.3 days in January crushing 19,684 and 23,940 tons respectively. Gross production $102,496, yield $2.34 per ton.

ALASKA TREADWELL (Treadwell)—Operated 240-stamp mill 30.75 days and 300-stamp mill 30 days in January crushing 30,688 and 44,800 tons ore respectively, gross value $146,326, yield $1.94 per ton. Net operating profit $61,642.

FAIRBANKS DISCOVERY CLAIM (Fairbanks)—Norwegian Mining Co. has found pay on Discovery claim, Fairbanks Creek, generally supposed to have been worked out years ago. Will prepare ground for summer mining. Contract let for delivery of 400 cords of wood over snow.

GRANITE MINE (Valdez)—Col. B. F. Millard, President, just returned from property reports first installment of new machinery has been delivered and is being installed. Oil tanks with capacity of 24,000 gal., 160-hp. engine and compressor are on the ground. New 10-stamp mill being made in San Francisco will soon be shipped. Ray Millard is Supt.

ARIZONA

Cochise County

LEONARD (Gleeson) — The Leonard copper mine held under option by Shannon Copper Co. is about to resume on same scale as previously.

Mohave County

COLUMBUS (Cerbat)—In a crosscut about 200 ft. from portal of old tunnel 6 ft. of zinc ore has been discovered. Some years ago considerable ore from tunnel was treated in Flores mill for gold, silver and lead. Presence of zinc was not suspected before crosscut was run.

TOM REED (Oatman)—Company recently purchased a Jeffry autotruck and trailer.

Pinal County

COPPER BUTTE (Florence)—Mine being unwatered preparatory to resuming operations. First work will be drifting on the 500-ft. level.

KELVIN-SULTANA (Kelvin)—Improvements are being made in mill and power-plant preparatory to resuming operations at both mine and mill.

Yavapai County

CASH (Prescott)—Operations have been resumed at Cash and Snoozer mines controlled by Commercial Mining Company. A 190-ft. winze has been sunk from one of the Cash drifts opening up good ore in the Snoozer ground. Enlargement of the local plant is contemplated.

CALIFORNIA

Amador County

FORTY-NINE FLAT (Volcano)—Gravel mine bonded to James Arditto and others of Amador City. Pay gravel recently encountered.

GRILLO (Volcano)—Inability to secure adjoining claim from J. Garibaldi compels Grillo brothers to suspend operations at gravel mine.

TIERAKOFF (Mokelumne Hill)—One ton of ore taken from adjoining claim milled at Tierakoff mill reported to have yielded 15 oz. gold.

CENTRAL EUREKA (Sutter Creek)—Ben Govis, Norwegian miner, 22 years old, killed by falling 150 ft. into sump from 3000-ft. station. Cause of fall unknown.

KEYSTONE (Amador City)—Have added 20 stamps to former 20-stamp mill. Mine began operation in the '50s. Has produced about $14,000,000. When present company took it over about three years ago, inclined shaft was 1400 ft. deep with a 200-ft. winze. The shaft is now 2400 ft. deep and orebodies have been found persisting at depth.

BUNKER HILL CONSOLIDATED MINING CO. (Amador City)—Superior Court jury at Jackson awarded heirs of Richard S. Matthews $5000 account of his death by electrocution in pump station on 800-ft. level. Suit was for $30,000. Plaintiffs filed notice of motion for new trial. Defendants claim Matthews entered station at his own risk, had no work there and had been warned to keep away.

Eldorado County

MOLYBDENITE discovery reported at Murray Hill on road between Placerville and Grizzly Flat by Thomas A. Murray. As result of chemical determination property was located as a mining claim.

JONES (Placerville)—More than $7000 has been taken out of pockets in this mine recently and indications of permanent ledge found. The flat in this vicinity yielded large amount of gold in the early days of quartz mining in the county.

Inyo County

PITTSBURG-LIBERTY (Masonic)—Fine-grinding and cyanide plant and 100-hp. gas engine being installed.

WESTERN HYDRATE LIME CO. (Los Angeles)—Installation of plant at Owens Lake contemplated, for treatment of magnesian lime produced by the Natural Soda Products Co. and heretofore shipped to Los Angeles and San Francisco for treatment.

Kern County

SUNSHINE (Randsburg)—Recent cleanup yielded $6250 bullion and $3600 concentrates. Ore is high-grade recently disclosed on 500-ft. level.

BALTIC (Johannesburg)—Mine recently sold at sheriff's sale to Indianapolis men, who are reported to be negotiating for other properties in vicinity.

KING SOLOMON (Randsburg)—Nosser Illingsworth lease has 12 tons of ore ready for milling that is estimated at $65 per ton. This lease has produced $17,000 in less than two years. The last milling, in January, yielded $800 from 10 tons of ore at the Red Dog mill.

STANFORD MINING & REDUCTION CO. (Johannesburg)—Installation of modern cyanide plant at Red Dog mill contemplated. Plant treats ores of Randsburg and other nearby districts and is the only strictly custom mill in this region. Crude method of cyanidation so long maintained and consequent high rates not satisfactory to mine owners and leasers.

Los Angeles County

ALLISON (Azusa)—Reported that property has been taken over by Marcus-Daly interests and that stamp mill and other machinery installed in 1914 will be replaced by modern mill. Mine is situated in San Gabriel cañon six miles north of Azusa. New roads are being constructed.

Nevada County

BRUNSWICK CONSOLIDATED (Grass Valley)—Installation of modern cyanide plant contemplated.

NORTH STAR (Grass Valley)—New 420-hp. compressor recently installed allows operation of three compressors instead of four and reduces the labor costs. Providence shaft will be enlarged to three compartments and will be retimbered entire 1800 ft. Double-reel electric hoist has been ordered and new headframe is under construction.

Placer County

ROUGH AND READY (Dutch Flat)—This old gravel producer in the early days of hydraulic mining, has been taken over by Federal Drift Mining Co. and will be worked by drift methods. Installation of a 250-ton mill for crushing cemented material is contemplated.

Trinity County

GLOBE CONSOLIDATED (Dedrick)—Carload of pebbles for tube mill received from Norway reported being carried from Redding to Dedrick by parcel post. The pebbles are sacked in 50-lb. sacks for postal shipment.

COLORADO

Gilpin County

FRONTENAC CONSOLIDATED MINES CO. (Central City)—All this company's holdings have been sold by the sheriff to creditors.

WOOD (Russell Gulch)—This mine, one of the few producers of pitchblende in this state, is being reopened under lease by Harry Willis.

PITTSBURGH EXTENSION (Central City)—H. B. Cannon, T. H. Reddington and J. G. May are directors of Future Mining Co., which has equipped this mine with new electrical machinery and will immediately begin operations.

COEUR d'ALENE (Black Hawk)—This and the Isabella properties have been acquired and will be operated by newly incorporated Coeur d'Alene Mining Co. of which W. F. Gray, of Goldfield, Nev., is president. Old shaft is being retimbered and shafthouse enlarged for new equipment.

Lake County

PENROSE (Leadville)—Retimbering shaft, preparatory to proposed unwatering of down-town mines, is progressing rapidly. Delivery of pumps from the east considerably behind contract date and entire project correspondingly delayed.

BIG FOUR (Leadville)—Resumption of operations delayed pending adjustment of insurance indemnities accruing from recent destruction by fire of surface plant. Meanwhile same interests, Big Five Operating Co., have leased and equipped the Fanny Rawlings, a neighboring property.

Ouray County

MOUNTAIN TOP (Ouray)—Winze has been sunk from adit, following vein 2 ft. wide averaging $40 per ton gold and silver.

San Miguel County

TOMBOY (Telluride)—Operated 60-stamp mill 28 days in February crushing 11,000 tons ore yielding $83,000 gross, and a profit of $27,000.

Summit County

JUNIATTA (Breckenridge)—Cumbre Mining Co. is installing electrically-driven Imperial Type Ingersoll-Rand compressor. Also a triplex pump in the shaft.

TONOPAH PLACERS CO. (Breckenbridge)—Plan to build a dam for raising the level of Mohawk Lake and conserving the heavy run-off from Spruce Creek during the summer seasons. Reported that company will build half million dollar hydro-electric plant.

Teller County

JO DANDY (Victor)—Thomas Kavanaugh and C. D. Gurney, operating the mill, are treating 2000 tons of $2 dump material per month.

MIDGET (Cripple Creek)—Shipped 25 cars ore in February. Shaft will be sunk additional 100 ft. from present depth of 950 ft. Surface plant will be enlarged.

DOCTOR-JACKPOT (Anaconda)—Starkweather and Wilson, during February, produced nearly 1500 tons of ore from a 20-ft. body that averaged close to 2 oz. gold per ton without sorting.

EL PASO (Cripple Creek)—New hoisting plant working to capacity handling ore broken and stocked underground during shaft's shut-down due to destruction of shafthouse by fire some months ago. Lessees holding unexpired contracts at time of fire have resumed their operations.

GOLD SOVEREIGN (Cripple Creek)—Shaft will be sunk 100 ft. to 1350-ft. level to bring bottom to elevation of lowest workings in Cresson mine and drift will then be extended to discover continuation of bonanza oreshoot now producing in this neighboring mine. James F. Burns secured control at recent annual meeting.

IDAHO

Custer County

EMPIRE COPPER (Mackay)—Property acquired under escrow agreement by Salt Lake interests headed by E. L. Godbe, of the Prince Consolidated. Empire is successor to White Knob Copper. Has spur connection to main line O. S. L. Ry., complete mine equipment, surface plant and dwellings for crew.

MICHIGAN

Copper

SOUTH LAKE (Houghton)—Passed through the fourth lode with its crosscut and has encountered 16 ft. of profitable stamp rock.

MOHAWK (Mohawk)—Now changing at No. 6, latest and southernmost of its shafts, from old skips of 2½ tons capacity to those able to hoist 7½ tons.

NEW ARCADIAN (Houghton)—Recently put into commission five more drills, making eight now in operation, working day shift. Compressor has capacity of ten drills.

MAYFLOWER (Houghton)—Drill hole No. 41 down about 2000 ft. cut St. Louis conglomerate lode at about 1850 feet. Ought to cut Mayflower lode within next 500 feet.

LAKE (Houghton)—Management considering plans for reopening mine. Former Manager Hitchcock here looking over property. Local shareholders opposed to consolidation with South Lake.

HANCOCK CONSOLIDATED (Hancock)—Adding to its underground forces rapidly. Would be in readiness to ship copper rock now if the mill could handle the product. Shipments will be commenced within 30 days. Working force 250.

QUINCY (Hancock)—Continues to operate but three mines and management has no plans as yet for resumption at Pontiac. Rock tonnage close to 4000 daily. Grade of rock little better than the average. In Mesnard shaft rock at lower levels contains much smaller amount barrel material and mass work.

Iron

ATHENS (Negaunee)—Shaft now down to depth of about 435 ft. Some bad ground encountered made progress slow and required placing concrete lining in 20-ft. sections, whereas it has been customary to treat 40-ft. sections.

OLIVER IRON MINING CO. (Iron Mountain)—On March 22, the Chapin and Argon mines will go on a four-day per week schedule. For the past year these properties have been working only three days per week.

MINNESOTA

ISLAND CREEK COAL CO. (Duluth)—Estimates for a 1000-ft. addition to company's coal dock in West Duluth, already 1000 ft. in length, are being considered. Present dock has two Heyl & Patterson coal-carrying bridges; would require at least one additional bridge with increased length of dock. Capacity would increase from 350,000 tons to 700,000 tons. Two present bridges have operating capacity of 6000 tons per hour.

HIGGINS LAND CO. (Duluth)—William J. Wallace, timber cruiser and mining engineer, has brought suit in Duluth courts to secure remuneration for services estimated by him to be worth $50,000, for obtaining data advantageously used by company in securing cancellation of certain mining lease given to U. S. Steel Corporation. Higgins Land Co., in which late Gov. Frank W. Higgins of New York was interested, has been in the courts on numerous occasions heretofore. Some months ago its erstwhile attorneys, Spencer & Marshall, secured verdict of $103,300 against it for services rendered in bringing about above mentioned cancellation of lease on Mesabi Range mineral lands.

Cuyuna Range

THOMPSON (Crosby)—It is stated unofficially that company will erect washing plant this season at Crosby.

ROWE MINE (Riverton)—Will construct washing plant on west side of Little Rabbit Lake. Trestle across lake now being constructed.

Mesabi Range

DEACON (Buhl)—New head frame erected by American Bridge Co. practically completed. Operations started for the season.

BARROWS MINING CO. (Barrows)—Hole being drilled to obtain a shaft location has unexpectedly encountered merchantable ore necessitating location of shaft at another site.

GREAT NORTHERN (Hibbing)—Officials state that efforts will be made to ship 6,000,000 tons this season if possible. Oliver company shipped 6,500,000 tons from these properties last season.

MONTANA

Beaverhead County

BOSTON & MONTANA DEV. CO. (Jackson)—Company has in its treasury total capital stock of Southern Montana Ry., which is to be constructed as soon as arrangements can be completed. Line will run from Divide terminal to Jackson in the Big Hole country with branches to French Gulch mines and Elkhorn district.

Silver Bow County

ANACONDA (Anaconda)—Company has signed contracts for $70,000 worth of steel tanks for flotation plant with penalty and bonus clauses applying to first shipment in 35 days. To be completed in 90 days.

AMERICAN ZINC CO. (Butte)—New organization has taken five-year lease on Emma mine of Butte. This has a zinc vein 300 ft. wide on the 800 level. Property formerly owned by Butte Mining & Development Co. Was developed for copper but turned into zinc and property was abandoned at time zinc mining in Butte was unprofitable.

BUTTE-DULUTH COPPER CO.—This company made a record run during February. Close to 150,000 lb. of copper was produced, of which 120,000 lb. was electrolytic and 30,000 lb. cement copper. Total tonnage handled was 7800 tons, at a total expense per ton, including development work, of about $1.99, equivalent to slightly less than 10c. per lb. of copper produced. The new ore shovel has proved its value and has handled as high as 84 tons of ore per hour, and after a few contemplated improvements is expected to handle 120 tons per hour. This will enable company to mine close to 1000 tons of ore per day, thus supplying the new plant to capacity.

NEVADA

Clark County

MOBILE (Goodsprings)—Negotiations for sale to Mobile Lead & Zinc Co. completed. Terms, $30,000; first payment in one year and balance in 18 months. Property well developed; has 2800-ft. aërial tramway.

Esmeralda County

PITTSBURGH SILVER PEAK (Blair)—Capacity reduced by dropping only 30 stamps in 120-stamp mill, reported to be due to limited amount ore in sight.

DAISY (Goldfield)—Three-foot shoot shipping-grade ore opened in raise from west drift on 265-ft. level; shipping will commence at once. Property operated under lease by Justice Gold Mines Co.

Humboldt County

NEVADA PACKARD (Rochester)—At February meeting of board, directors decided to build stamp mill and cyanide plant. Ore being sent to several testing plants to determine best method. Mill may be built with sufficient capacity to treat custom ore. Telephone connection between mine and main office, at Lovelock, installed.

Lander County

TIN STRIKE NORTH OF BATTLE MOUNTAIN continues to cause excitement. Excellent samples of stream tin on exhibition at Battle Mountain.

Mineral County

AURORA CONSOLIDATED (Aurora)—New machinery to be installed in mill shipped; expected operations will be resumed Apr. 1.

Nye County

TONOPAH PRODUCTION for week ended Mar. 6 was 10,408 tons, estimated gross value $213,304, as follows: Tonopah Belmont, 3847; Tonopah Mining, 2250; Tonopah Extension, 1680; West End, 1231; Jim Butler, 1100; Tonopah Merger, 150; Montana-Tonopah, 150 tons.

TONOPAH EXTENSION (Tonopah)—New oreshoot, 2½ ft. wide, opened recently on 500-ft. level.

TONOPAH VICTOR (Tonopah)—Pumping and bailing being done; 500,000 gal. water daily being lifted.

TONOPAH MINING CO. (Tonopah)—Stated that complete control of Panama Mining Co., in Nicaragua, has been assumed by this company.

SUNSET MINING & DEVELOPMENT CO. (Bullfrog)—Capacity of 40-ton plant will be doubled. Tunnel will be driven into Denver ground.

NEVADA CINNABAR CO. (Ione)—Shipment 350 flasks quicksilver made recently. Scott furnace operating produces 25 flasks daily. New body rich ore opened recently. Production will be increased.

JOHNNIE MINING & MILLING CO. (Johnnie)—Sold for taxes recently, will be redeemed by receivers, indebtedness liquidated, corporation dissolved and work resumed after reorganization. Mine produced three-quarter million dollars in past.

ROUND MOUNTAIN MINING CO. (Round Mountain)—Rapid progress being made delivering eight miles of 15-in. spiral-riveted pipe for its placer operations. Auto trucks used in haul from Tonopah and six to eight 10-horse teams from Austin.

Storey County

YELLOW JACKET (Virginia City)—New pumps for incline shaft received. Water will be held below 1500-ft. level.

MEXICAN (Virginia City)—Pumps will be installed in joint Mexican-Ophir winze to lower water 200 ft.; winze will then be changed from three compartments to two. Excavation for hoist completed.

White Pine County

OPHIR (Ely)—Group of 12 claims in Red Hills district purchased by A. R. Shepard for $40,000. First payment of $4000 to be made within 90 days, $18,000 in 12 months, and balance by July 19, 1916. During this period 20% of gross returns from shipments to be applied on purchase price.

NEW MEXICO

Grant County

WARNOCK & WALTERS (White Signal)—New hoist and equipment now ready for work. Operators will go down 300 ft.

Luna County

BI-METALLIC (Sierra Blanca)—Company in receipt of new equipment. Being assembled and tested at Deming before removal to mine. Alamo 25-hp. engine, air compressor and drills in equipment.

Sierra County

EUREKA (Hillsboro)—Contract let by F. W. Moffett for 350-ft. development work. Old shaft will be extended 100 ft. from 105-ft. level and 250 ft. drifting will be done.

OREGON

Baker County

ORO FINO (Alamo)—This mine is to be put in operation again after being idle for a number of years.

GOLDEN GATE (Greenhorn)—Mill started. Development in progress since 1900. Ore oxidized and good milling value at 350-ft. depth.

MAID OF OREGON (Alamo)—Contractors at this property making good headway with development work in crosscut. Vein thought to be near present face of workings.

Josephine County

SISKIYOU MINING & DREDGING CO. (Pleasant Creek)—Prospecting some deep placer ground with Keystone drilling machine.

MONITOR MINE (Susanville)—John Howard is operating this mine under a bond and lease. Property joins Badger mine which is being developed.

ORIOLE MINE (Galice)—Corey Mattison of this mine reports that new vein of high-grade quartz has been struck and some of the samples shown are rich free-gold specimens. Vein said to be 4 ft. wide.

SOUTH DAKOTA

Lawrence County

MOGUL (Terry)—A raise is being driven from Ben Hur to connect with Carstreet at surface which will make possible hoisting ore direct to mill bin.

ANACONDA (Roubaix)—Steam has been turned on at the new shaft. Several months spent in removing equipment to new location. Shaft sinking will now be pushed.

ECHO (Maitland)—Shaft 50 ft. deep. New equipment of electric machinery has been installed. Company intends to sink several hundred feet to open orebodies disclosed in adit workings.

ORO HONDO (Deadwood)—Station being cut at 1550 ft. from which lateral work will be done coincidently with continuation of shaft. Diamond drills will be used from this level. Auxiliary hoist will be located here.

WASP NO. 2 (Flatiron)—Mill and mine are being worked at half capacity permitting greater length of cyanide treatment, resulting in improved mill extraction. M. H. Pilcher appointed mill superintendent, succeeding R. W. Craig, resigned on account of ill health.

HEIDELBERG (Deadwood)—Company considering proposition to extend electric power lines to property, distance of 2½ miles, at cost of $3500. Believed this would be more economical than steam plant considering cost of hauling fuel over several miles of rough mountain road. Company plans to sink 200 to 300 ft. additional; shaft is now 180 ft. deep.

UTAH

Beaver County

MAJESTIC (Milford)—Work is to be resumed at company's Hoosier Boy property.

MOSCOW (Milford)—Drifting from 1100-ft. level, the bottom of the new shaft, has opened continuation of oreshoot from the 800-ft. level.

CEDAR-TALISMAN (Milford)—Ore carrying 32 to 35% zinc is being mined and hauled to Milford. Three cars are ready for shipment.

PALOMA (Milford)—At this property near the Moscow, shaft is down 375 ft., and there is 2 to 3 ft. of ore assaying well in silver and lead.

Juab County

KING WILLIAM (Tintic)—Lease held by U. S. Smelting, Refining & Mining Co. dropped after expenditure of a considerable sum of money. Said to be in line with general orders of company discontinuing much of its prospecting in various sections in the states and Alaska.

Salt Lake County

COLUMBUS EXTENSION (Alta)—Zinc ore is being developed on the contact of limestone and quartzite.

EMMA COPPER (Alta)—Company reorganized recently, F. R. Snow is president. Work is to be started, arrangements being made with Wasatch Mines Co., to work through either the Flagstaff or the Buffalo tunnel.

MONTANA-BINGHAM (Bingham)—Progress of 4 ft. daily being made in tunnel, which is 8x9 ft. in the clear. Considerable water has been encountered. Siding has been built from D. & R. G. tracks in Bingham cañon to tunnel.

UTAH APEX (Bingham)—Net earnings for January, $22,129; gross receipts, $67,365 from sale of 4082 tons of shipping ore and 3276 tons of concentrates. Ore milled, 9701 tons, at cost of 66c. per ton. Shipping ore produced at cost of $2.70 and milling ore at $3.52 per ton.

Summit County

PARK CITY ORE SHIPMENTS for February, 9096 tons crude ore and concentrates. During week ended Mar. 6, there were shipped 4,212,880 lb. ore from Silver King Coalition, Daly-Judge, Daly West and Silver King Consolidated.

SILVER KING CONSOLIDATED (Park City)—Ore has been opened on 1800-ft. level, lowest in mine.

WASHINGTON

NORMAN LEAD MINING CO. (Northport)—Reported to be about to install new machinery. Sidney Norman, Spokane, is manager.

CANADA

Ontario

SILVER- AND NICKEL-ORE SHIPMENTS over the Temiskaming & Northern Ontario Ry., for February amount to 1032.88 tons and 839.15 tons respectively. All the nickel came from the Alexo mine at Porcupine, and the silver as follows: Cobalt; Beaver, 31.66 tons; Chambers Ferland, 39.99; Cobalt Comet, by Dom. Red. Co., 33.47; Coniagas, 57.53; Crown Reserve, by Dom. Red. Co., 50.77; Kerr Lake, by Dom. Red. Co., 31.16; La Rose, 45.52; McKinley Darragh, 123.37; Mining Corporation of Canada, Ltd., Cobalt Lake Mine 65.05 and Townsite City Mines, 249.13; Nipissing, 30.23; O'Brien, 30.46; Penn Canadian, 50.43; Peterson Lake—Seneca Superior, 31.27; Temiskaming, 98.85; Trethewey, 43.39. From Elk Lake, Miller Lake O'Brien, 20.60.

ACME (Porcupine)—Milling ore in Hollinger mill, using 20 of Hollinger's new 40 stamps.

RIGHT-OF-WAY (Cobalt)—Last year shipped ore of $66,135 gross value. Milling expenses $19,941.

NORTH THOMPSON (Porcupine)—Work has been suspended for the present.

HOLLINGER (Porcupine)—Will use electric locomotives on the main haulage levels which will be 400 ft. apart.

McINTYRE (Porcupine)—Treated 10,900 tons in February averaging $8.77 and recovered bullion to the value of $56,000.

DOME (Porcupine)—In February treated 21,600 tons and recovered $84,412. Mill ran 97% of the time. Average ore was $3.90 per ton.

O'BRIEN (Cobalt)—Production for 1914 was 1,237,345 oz. of which high-grade ore produced 452,772 ounces. Mill treated 41,949 tons. Ore reserves were depleted by 350,000 ounces.

NIPISSING (Cobalt)—During February mined ore estimated at $164,140, and shipped bullion from Nipissing and custom ore estimated net value of $183,646. High-grade mill treated 165 tons and low-grade mill treated 4695 tons.

GIBSON-KIRKLAND LAKE SYNDICATE is name of new company, financed by English capital, which has taken over seven claims in Teck and Lebel townships, about a mile north of the Tough Oakes mine.

CROWS' NEST COAL (Alberta)—Net earnings for 1914 were $263,000, a decrease of $210,000 compared with previous year. Market for coke disappeared with closing down of copper smelteries. General business for coal throughout west was poor.

TEMISKAMING (Cobalt)—Annual report shows operating loss for past year $81,422. Production 278,961 ounces from which was realized $136,334, total income was $146,649. Total expenses were $228,071. New vein from the Beaver for 100 ft. shows high grade most of distance. There are 6000 tons of low-grade ore broken in mine.

MEXICO

San Blas—Sinaloa

ORDER HAS NOT BEEN RESTORED and the only companies that have tried to work of late are the Lluvia de Oro in Chihuahua and the Potrero in the Mocorito district. An engineer operating a gold-copper property writes: "We have been in the thick of the war and for six months have had from 500 to 4000 soldiers in the vicinity, one side having the place at times and the other side at other times. Nevertheless have been able to keep our mine near here going due to luckily having gotten in a year's supply of ammunition just before the fracas began."

Sonora

CARNEGIE LEAD & ZINC CO.—Organized by interests identified with Calumet & Sonora M. & M. Co., to take over and operate latter's property undergoing foreclosure proceedings. R. P. Burgan, President, Pittsburgh, bid in for $82,000 at trustee's sale the 2500 shares of Cananea Mining Co., held by the Calumet & Sonora. This stock was held by the trustees to guarantee interest payment on a $100,000 bond issue floated when the company undertook the development of Mexican property. Stock of original company held largely by Duluth interests.

AFRICA

Rhodesia

GOLD PRODUCTION in January was 70,082 oz., being 3807 oz. less than December, but 10,635 oz. more than in January, 1914. Other mineral production in January included 13,802 oz. silver, 249 tons copper, 1 ton lead, 26 tons asbestos, 8176 tons chrome ore and 30,470 tons coal.

Transvaal

GOLD PRODUCTION IN FEBRUARY is reported by cable at 676,221 oz. fine; which is 38,763 oz. less than January, but 49,960 oz. more than February, 1914. For two months ended Feb. 28 total gold reported was 1,278,014 oz. in 1914, and 1,391,205 oz., or $28,756,207, in 1915; an increase of 113,191 oz., or 8.8%, this year.

The Market Report

METAL MARKETS

NEW YORK—March 17

Copper has been stronger without much increase of business. Tin experienced a spectacular rise because of the shortage in spot supply. Lead advanced sharply on large buying for export. Spelter has not yet recovered from the collapse and the market is still but nominal.

Copper, Tin, Lead and Zinc

Copper—In the early part of the week some business was done with domestic consumers at 14¾c., regular terms. On Mar. 15 a little increase in demand caused an advance. Some small sales were reported even at 15c., regular terms, and that price was also received by certain sellers in non-competitive markets. There was not, however, any important buying at that figure, copper being freely offered at 14¾ @ 14⅞c., regular terms, while those who were asking the higher price reported their inability to realize it. The condition seems to be that the market is strong on account of its excellent statistical position, but at the moment there is relatively little buying. The foreign markets are now wholly out of joint with the American, and for the time being the ordinary situation of international parity does not exist. For example, copper actually in London may be sold there at prices considerably above the New York price. With respect to sales for export, there are all kinds of uncertainties as to exchange, insurance and freights, and even of freight room at all, and a shipper can seldom figure out what he is going to realize until the business is completed.

Copper sheets show no change in the base price, which is 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is quoted at 15¾ @16c. per lb., carload lots at mill.

Copper exports from the United States for the week ended March 6 are reported by the Department of Commerce at 11,829,000 lb. The larger items were 7,861,000 lb. to France, 4,209,000 lb. to Great Britain, 224,000 lb. to Italy and 110,000 lb. to Australia. Imports for the week were: Metal 5,448,000 lb., in ore and matte, 1,$62,000 lb.; total 6,510,000 lb. The imports were from Spain, Peru, Chile and Canada.

Exports from Baltimore for the past week included 2,689,496 lb. copper to Stockholm, Sweden.

Brass Prices have been again advanced about ½c. the latest base prices being given out by the American Brass Co. as follows, to date from March 3: Sheets, high brass, 17¾c. net per lb.; low brass, 18⅞c. Wire, high brass, 17½c.; low brass, 18⅞c. Rods, high brass, 17½c.; low brass, 19⅝c. Tubes, brazed, 21⅜c.; open seam, 21⅜c. Angles and channels, 21⅜c. Scrap allowances are 12¼c. net per lb. for high brass; 12⅞c. for low brass.

Tin—The difficulty in arranging shipments from London hither has produced a condition threatening complete shortage of spot supply here. At the beginning of March the spot supply was only 2046 tons, and since then only 80 tons have come in. The conditions are similar to what existed last August, except that consumers are not obsessed by the panic that they experienced then. The existing conditions have, however, produced a large advance in price upon only small business.

Tin ore arrivals in Great Britain in February were three tons of bars from Bolivia; 4801 tons concentrates from Bolivia, 621 tons from Nigeria and 66 tons from South Africa; in all 5488 tons concentrates and 3 tons bars, equivalent to 2365 tons fine tin.

Tin output of Federated Malay States two months ended Feb. 28 was 8538 tons in 1914, and 7379 in 1915; decrease 11.59 tons.

Lead—In the early part of the week the market was strong and advancing, especially in St. Louis where important sales for export began as early as Friday. On Mar. 15, very large sales for export were made, and on Mar. 16, the A. S. & R. Co. was led thereby to advance its price to 4.10c. at noon, no sales having been made from that quarter in the morning. Independent producers, however, had been large sellers. The situation is perplexing, there being nothing in the domestic trade justifying an advance in lead, and during the last week the same producers sold to domestic consumers at five to ten points below what they got for shipment abroad. On Mar. 16, round lots were sold to domestic consumers at 3.90c., St. Louis, while we quote for that day 3.95@4.05, in order to represent the average of all business, domestic and foreign. Sales were made for shipment from St. Louis to Europe through Gulf ports, which explains the contraction of the normal differential between New York and St. Louis.

The spot price of lead in London is far above our parity, but the difficulty of finding freight room keeps the English and American markets apart. Some of the export sales made last week were for delivery abroad, while others were f.o.b. New York and St. Louis, the buyer taking the responsibility of delivery. The total volume of the export business consummated during the last week must have been 15,000 to 20,000 tons. There were large sales to Russia. An unex-

DAILY PRICES OF METALS IN NEW YORK

Mar.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
11	4.8000	51½	14.55 @14.60	45	3.95 @4.00	3.87½ @3.92½	*7.92½ @8.17½	*7.75 @8.00
12	4.8013	51⅛	14.55 @14.60	49	3.95 @4.00	3.90 @3.95	*7.92½ @8.17½	*7.75 @8.00
13	4.7950	51⅛	14.55 @14.60	49	3.95 @4.00	3.90 @4.00	*7.92½ @8.17½	*7.75 @8.00
15	4.8025	51½	14.55 @14.75	51	3.95 @4.05	3.90 @4.00	*7.92½ @8.17½	*7.75 @8.00
16	4.8025	51½	14.55 @14.75	52	4.05 @4.10	3.95 @4.05	*7.92½ @8.17½	*7.75 @8.00
17	4.8000	50¾	14.55 @14.75	52 @53	4.10 @4.15	4.00 @4.10	*7.92½ @8.17½	*7.75 @8.00

* Nominal.

The quotations herein are our appraisal of the markets for copper, lead, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.-Mar.	Silver	Copper				Tin		Lead		Zinc	
		Spot									
		£ per Ton	Cts. per Lb.	3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
11	24 5/16	64¾	14.07	65⅛	....	189	165½	21	4.56	44½	9.67
12	24 5/16	64¾	14.07	65¼	....	189½	167½	21⅜	4.64	44½	9.67
13	24 5/16	....	....	....	....	....	....	....	....	....	....
15	24¼	65¼	14.18	65½	....	190	166½	22 3/16	4.82	44½	9.67
16	24⅛	66	14.34	66½	....	188	168½	23	5.00	44½	9.67
17	23 13/16	66	14.34	67	....	190	170¾	23	5.00	44½	9.67

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10=2.17½c.; £15=3.26¼c.; £20=4.35c.; £30=6.52c.; £60=13.05c. Variations, £1 = 0.21¾c.

plained interruption of England's supply of lead from Spain seems also to have played a part in creating the large demand for lead from here.

The Missouri lead producers have increased their production. The St. Joseph Lead Co. went upon a 90% basis on Mar. 15. The Cœur d'Alene producers have not yet inaugurated any increase or shown any tendency so to do.

Spelter—This market has not yet settled following the shock of the previous week, and still may be quoted only as nominal, the business reported as actually done having been very small. Consumers apparently no longer want to buy. At the beginning of our week of record, resale offers from several consumers, in certain cases of considerable quantities, promised to be a disturbing factor, but the news of a strike among the smelters in Oklahoma on March 13, called a halt pending observation as to what this would amount to. The smelters demanded 50c. per day advance in wages all around. At one of the works at Collinsville the men went out and the furnaces were dead-fired. At Bartlesville, Caney and Dearing, there was no interruption of work, the men remaining on duty pending consideration of their demands. On Mar. 17, it was reported that a compromise had been effected and labor trouble is probably averted. While the spot price of spelter in London has been above our parity, it has been impossible to sell for later delivery in England.

Zinc sheets are quoted today at $13.50 per 100 lb. f.o.b. La Salle, Ill., less 8% discount. Usual extras charged.

Other Metals

NEW YORK—March 17

Aluminum remains quiet but rather steady. Quotations are unchanged at 19@19¼c. per lb. for No. 1 ingots, New York.—**Antimony** is in short supply and prices are strong, though business has been on a small scale. Ordinary brands are 21½@23c. per lb. Cookson's is nominal in the absence of supplies, but 27@29c. per lb. has been offered—**Nickel** is unchanged, ordinary forms being 40@45c. per lb. according to size and terms of order. Electrolytic, 3c. higher—**Quicksilver** has been strong and excited. Supplies for spot delivery are very scarce here, and for small lots as high as $75@80 per flask has been paid. For large lots dealers will not quote, having none to deliver. London price is £12 10s. per flask, with £12@12¼ named from second hands.

Gold, Silver and Platinum

NEW YORK—March 17

Gold—A total of $1,250,000 gold is reported on its way to New York from Japan. A shipment of $2,500,000 gold from Ottawa to New York was made this week.

Silver—The market has not been maintained the last few days owing to smaller inquiry. No shipments of bullion were made from New York to London last week, owing to the non-sailing of steamers. This week two steamers sailing under the American flag will probably carry silver.

Platinum—Nothing new has developed in the platinum market, which remains quiet with small sales. The chief demand just now is for hard metal, which seems to hold its price better than refined platinum. Most of the large producers, however are covered by contracts. Prices are a little variable, and we continue to quote $38@42 per oz. for refined platinum and $44@49 per oz. for hard metal.

JOPLIN, MO.—Mar. 13

Blende, high price $75; assay base 60% zinc, low in lead, $73@70; high in lead, $69@55; metal base suspended; calamine base 40% zinc, $40@35; average, all grades of zinc, $69 per ton. Lead, high price $49.90; base, $48 per ton of 80% metal content; average, all grades of lead, $47.55 per ton.

General decline in all zinc prices at the week-end.

SHIPMENTS WEEK ENDED MAR. 13

	Blende	Calamine	Lead	Values
Totals this week..	9,006,710	277,590	1,540,870	$353,440
Totals this year..	108,078,530	9,973,760	16,211,910	3,846,860

Blende value, the week, $310,740; 11 weeks, $3,283,010.
Calamine value, the week, $6080; 11 weeks, $181,700.
Lead value, the week, $36,620; 11 weeks, $382,150.

PLATTEVILLE, WIS.—Mar. 13

The base price paid this week for 60% zinc ore was $70@71 The base price paid for 80% lead ore was $48 per ton.

SHIPMENTS, WEEK ENDED MAR.13

	Zinc Ore, lb.	Lead Ore, lb.	Sulphur Ore, lb.
Week	5,093,040	148,390	168,700
Year	40,343,760	618,390	3,728,600

Shipped during week to separating plants, 3,809,270 lb. zinc ore.

Iron Trade Review

NEW YORK—March 17

The iron and steel trades hold fairly well to the increased working schedules. New business has been a little uneven but the total reported is considerable.

Structural orders are improving, and there is a good demand for plates and shapes for shipbuilding, which is active on the seaboard.

Pig iron is less active, but a better demand is expected in the second half of the month. More orders are reported for export, especially of Alabama iron.

The ferromanganese situation is rather serious. Stocks are getting low and the imports from England are coming very slowly indeed.

The United States Steel Corporation reports the unfilled orders on its books on Feb. 28 at 4,345,371 tons of material. This is 96,800 tons more than on Jan. 31; 508,723 tons more than on Dec. 31, 1914; and 1,020,779 tons more than on Nov 30, which was the lowest point reached last year.

PITTSBURGH—Mar. 16

The increase of 96,800 tons in the Steel Corporation's unfilled obligations during February, against increases of 411,928 tons in January and 512,051 tons in December, is not to be regarded as making an unfavorable showing for February, since the compilation is affected chiefly by contract tonnage, and February, falling in the middle of the quarter, naturally witnessed relatively little contracting.

The steel mills are now operating at an average of not less than 65% of their steel ingot capacity, approximately double the rate of last December, and showing a slight increase since the first of the month. Apparently business is being booked at a rate sufficient to maintain the present output. It is generally believed that the current production is all being shipped and is passing into actual consumption, so that heavier demands upon the mills are to be expected as the weather permits of more extensive outdoor operations.

Steel prices are steady to firm, but are not subjected to any severe tests as most of the shipping orders being booked are against old contracts.

Pig Iron—The market is practically stagnant, and the situation is disappointing, as a distinct contracting movement, at least in foundry pig iron, was expected by this time. Contracts closed late last year for the first quarter have not been specified against very well, and the quarter will end with considerable tonnages still due. Prices remain quotable as follows: Bessemer, $13.60; basic, $12.50; No. 2 foundry, $12.75@13.25; malleable, $12.75; forge, $12.50@12.75, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—There are no new developments. The contract price remains at $78, Baltimore, as recently advanced. Prompt lots command about $100.

Steel—There is nothing being done in billets and sheet bars, consumers' requirements being fully met under old contracts. Billets are $18.25@18.50 and sheet bars $18.75@19, Youngstown, and $1 a ton higher at Pittsburgh. Rods are $25, Pittsburgh.

COKE

Connellsville—The Perry Iron Co., Erie, Penn., has closed a contract with the Orient Coke Co. for 10,000 to 12,000 tons of furnace coke monthly to the end of the year, at $1.75 or a trifle less, this being the only contract closed for a long time. Spot coke is very quiet. Prices are quotable as follows, though the quotations are largely nominal: Prompt furnace, $1.50; contract furnace to July 1, $1.60; to Dec. 31, $1.75; prompt foundry, $2@2.35; contract foundry, $2.15@2.30, per net ton at ovens.

Anthracite shipments in February are reported at 4,275,107 long tons, which is 459,478 tons less than in January, but 153,656 tons more than in February, 1914. For the two months ended Feb. 28 the total shipments were 9,297,193 tons in 1914, and 9,009,692 tons in 1915; a decrease of 287,501 tons this year.

Chemicals

NEW YORK—March 17

Arsenic—The market remains quiet, and no large business is forward. Prices are steady at $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is about as usual. Quotations are unchanged at $5.50 per 100 lb. for carload lots and $5.75 per 100 lb. for smaller orders.

Nitrate of Soda—Businss is a little irregular, but prices hold well. Quotations are 2.20c. per lb. for spot and up to July 1; and 2.17½c. for later deliveries.

Assessments

Company	Delinqe	Sale	Amt.
Caledonia, Nev.	Mar. 8	Mar. 31	$0.05
Challenge, Nev.	Mar. 31	Apr. 21	0.05
Confidence, Nev.	Mar. 11	Mar. 31	0.10
Con. Virginia, Nev.	Feb. 24	Mar. 18	0.10
Copper King, Ida.	Mar. 1	Apr. 1	0.005
East Hercules, Ida, (post.)	.....	Apr. 7	0.001
Eastern Star, Ida.	Mar. 25	Apr. 25	0.002
Emerald, Utah (three instal.)	.....	June 9	0.01
Enterprise, Ida.	Mar. 20	Apr. 20	0.002
Galena King, Utah.	Mar. 25	Apr. 25	0.0075
Idaho-Nevada, Ida.	Mar. 10	Apr. 2	0.002
Index, Ida.	Feb. 27	Mar. 27	0.005
Indiana, Mich.	Feb. 4	.....	1.00
Iron King, Ida.	Feb. 18	Mar. 19	0.001
Jack Waite, Ida.	Mar. 1	Mar. 24	0.01
Kentuck, Nev.	Mar. 18	Apr. 7	0.02
Keystone, Utah. (post)	Feb. 23	Mar. 23	0.02
King Pine Crk., Ida.	Feb. 12	Mar. 13	0.002
Laclede, Ida.	Mar. 20	Apr. 6	0.003
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Nabob, Ida.	Mar. 18	Apr. 12	0.005
Neva, Utah,	Mar. 18	Apr. 12	0.002
Oreano, Ida.	Mar. 25	Apr. 26	0.0015
Overman, Nev.	Mar. 8	Mar. 26	0.05
Pioche Metals.	Mar. 20	Apr. 20	0.0025
Rescue-Eula, Nev.	Feb. 11	Mar. 22	0.01
Rio Grande, Utah.	Mar. 25	Apr. 17	0.003
Saltese, Ida.	Mar. 1	Apr. 1	0.002
Selma, Utah.	Mar. 20	Apr. 6	0.0025
Silver Cliff, Ida.	Apr. 3	Apr. 24	0.0025
Snowstorm Ex., Ida.	Feb. 19	Mar. 22	0.003
Sonora, Ida.	Mar. 15	Apr. 15	0.002
Sunset, M. & D., Nev.	Mar. 27	May 3	0.015
Syndicate, Ida. (post.)	.....	Jan. 28	0.001
Tarbox, Ida. (post.)	.....	Mar. 25	0.0025
Tar Baby, Utah.	Mar. 5	Apr. 5	0.005
Tonopah Midway, Nev.	Mar. 12	Apr. 12	0.01
Torino, Ida.	Feb. 20	Mar. 20	0.001
Union Chief, Utah.	Feb. 18	Mar. 15	0.01
Utah, Nev.	Mar. 25	Apr. 15	0 02
Utah-United, Utah	Feb. 20	Mar. 15	0.01
Wanlass.	Jan. 30	Mar. 20	0.00375
Wolf Mountain, Utah.	Mar. 15	Apr. 14	0.0015

Stock Quotations

Copper stocks have continued strong. The decline in spelter prices was reflected in the zinc stocks.

COLO. SPRINGS Mar. 16		SALT LAKE Mar. 16	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05¼	Beck Tunnel	.06
Banner	.01¼	Black Jack	.10
Cripple Cr'k Con.	.007	Colorado Mining	.10½
C. K. & N.	.06½	Crown Point	.01¾
Doctor Jack Pot.	.08½	Daly-Judge	5.25
Elkton Con.	.44¾	Gold Chain	.08½
El Paso	1.37	Grand Central	.56
Findlay	.03½	Iron Blossom	.99
Gold Dollar	.04	Little Bell	.14
Gold Sovereign	.06½	Lower Mammoth	.05½
Isabella	.16¼	Mason Valley	1.10
Jack Pot	.06	May Day	.13
Jennie Sample	.02	Opohongo	‡.01½
Jerry Johnson	.03	Prince Con.	.37
Lexington	.0075	Seven Troughs	.01½
Mary McKinney	.32	Silver King Coal'n.	3.12½
Pharmacist	.01	Silver King Con.	1.85
Portland	1.14	Sioux Con.	‡.05½
Raven B. H.	.03	Uncle Sam	.04½
Vindicator	1.49¼	Yankee	.05

TORONTO Mar. 16			
Bailey	.02	Dome Exten.	.08
Coniagas	4.50	Foley O'Brien	.18
Peterson Lake	.23	Hollinger	22.25
Right of Way	.02	Imperial	.01
Seneca Superior	1.25	Jupiter	.09
Silver Queen	.02	McIntyre	.35
T. & Hudson Bay	24.00	Pearl Lake	.02
Timiskaming	.22½	Porcu. Gold	‡.25
Wettlaufer-Lor.	.05	Preston E. D.	.01½
Big Dome	7.50	Rea	.12

SAN FRANCISCO Mar. 16			
Comstock Stocks		Misc. Nev. & Cal	
Alta	.04	Belmont	4¼
Belcher	.30	Jim Butler	75
Best & Belcher	.06	Lone Star	.06½
Caledonia	.28	MacNamara	.04
Challenge Con.	.03	Midway	.16
Confidence	.20	Mont.-Tonopah	.45
Con. Virginia	.13	North Star	.15
Crown Point (Nev.)	‡.32	Rescue Eula	.10
Gould & Curry	.03	West End Con.	.53
Hale & Norcross	.04	Atlanta	.47
Julia	‡.01	Booth	.28
Mexican	.38	C.O.D. Con.	.06
Occidental	.79	Comb. Frac.	.07
Ophir	.09	Jumbo Extension	.95
Overman	.10	Pitts.-Silver Peak	.10
Potosi	‡.02	Round Mountain	.37
Savage	.04	Sandstorm Kendall	.09
Sierra Nevada	.07	Silver Pick	.08
Union Con.	.08	Central Eureka	‡.25
Yellow Jacket	.47	So. Eureka	‡2.25

N. Y. EXCH. Mar. 16	
Name of Comp.	Clg.
Amalgamated	54¾
Am.Sm.&Ref.,com.	64
Am. Sm. & Ref., pf.	102½
Am. Sm. Sec., pf. B.	‡78
Anaconda	26½
Batopilas Min.	.50
Bethlehem Steel	57½
Bethlehem Steel, pf.	103
Chino	35½
Colo. Fuel & Iron	23½
Federal M. & S., pf.	‡ 41¾
Great Nor., ore., ctf.	31⅛
Guggen. Exp.	49¼
Homestake	115½
Inspiration Con.	21⅛
Mex. Petroleum	66⅛
Miami Copper	21½
Nat'l Lead, com.	52
National Lead, pf.	106
Nev. Consol.	11¼
Ontario Min.	2
Phelps Dodge	‡175
Quicksilver, pf.	1½
Ray Con.	17⅛
Republic I&S, com.	19½
Republic I&S, pf.	76
SiossSheffl'd, com.	25
Tennessee Copper	27½
Utah Copper	52½
U. S. Steel, com.	45
U. S. Steel, pf.	104¼

N. Y. CURB Mar. 16	
Name of Comp.	Clg.
Beaver Con.	.24
Big Four	.06
Blue Bell	.06
Braden Copper	7
Buffalo Mines	.65
Can. Cop. Corpn.	‡1
Can. G. & S.	.03
Caribou	‡.45
Chambers Feriand.	.14
Con. Ariz. Sm.	5/16
Coppermines Cons.	‡1½
Davis-Daly	.88
Diam'field-Daisy	.07½
Dia. Black B.	.03½
Ely Con.	‡.01
Florence	.60
Goldfield Con.	1¾
Goldfield Merger	.24
Greene Cananea	.26
Kerr Lake	4⅛
La Rose	⅜
McKinley-Dar-Sa.	.45
Mines of Am.	2
Mutual Min., pf.	‡2½
Nevada Hills	.23
New Utah Bingham	.42
Nipissing Mines	5¼
Ohio Copper	.08
Oro	.13
Pacific Smelt.	‡1/32
South Utah	8
Stand'd Oil of N.J.	395
Standard S. L.	1⅜
Stewart	1⅞
Tonopah	7 9/16
Tonopah Ex.	2⅞
Tonopah Merger	.40
Tularosa	⅛
West End Ex.	.03
Yukon Gold	2⅞

LONDON Mar. 5			
Alaska Tre'dwell	£7	2s	6d
Camp Bird	0	6	9
El Oro	0	9	0
Esperanza	0	10	0
Mexico Mines	3	17	6
Oroville	0	11	9
Philippine Dr.	1	0	0
Santa Gert'dis.	0	11	3
Tomboy	1	3	1½
Tough Oakes	0	13	9

BOSTON EXCH Mar. 16	
Name of Comp.	Clg.
Adventure	1½
Ahmeek	295
Alaska Gold M.	33¼
Algomah	.50
Allouez	41½
Am. Zinc	26½
Ariz. Com., ctfs.	3¾
Bonanza	.32
Butte-Ballaklava	2¾
Butte & Superior	47½
Calumet & Ariz.	53¾
Calumet & Hecla	393
Centennial	17½
Copper Range	34½
Daly West	2½
East Butte	9½
Franklin	5
Granby	67½
Hancock	11½
Hedley	27¼
Helvetia	.30
Indiana	3½
Island Cr'k, com.	42½
Island Cr'k, pfd.	86½
Isle Royale	20½
Keweenaw	2
Lake	7⅛
La Salle	3½
Mass.	4½
Mayflower	4
Michigan	.80
Mohawk	58½
New Arcadian	5
New Idria Quick	‡3½
North Butte	24¾
North Lake	‡1
Ojibway	.75
Old Colony	3¾
Old Dominion	40
Osceola	73
Quincy	55½
Santa Fe	1 5/16
Shannon	5
Shattuck-Ariz.	21½
Superior	27
Superior & Bost.	1
Tamarack	30½
Trinity	4
Tuolumne	.25
U. S. Smelting	21
U. S. Smelt'g, pf.	40½
Utah Apex	2¼
Utah Con.	9¼
Victoria	1¼
Winona	2¼
Wolverine	42½
Wyandot	.50

BOSTON CURB Mar 16	
Name of Comp.	Bid.
Alvarado	.70
Bingham Mines	3½
Boston Ely	.14
Butte & Lon'n Dev.	.21
Calaveras	1½
Calumet-Corbin	.16
Chief Con.	.85
Corbin	‡.50
Cortez	.15
Crown Reserve	.80
Eagle & Blue Bell	.80
First Nat. Cop.	1⅛
Houghton Copper	1 5/16
Iron Cap Cop., pf.	3
Majestic	.12
Mexican Metals	.19
Nevada-Douglas	.37
New Baltic	1½
Oneco	.45
Raven Copper	.07
Smokey Dev.	.10
So. Lake	4¼
Tonopah Victor	‡.17
Trethewey	.13
United Verde Ext.	3 5/16

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	.....	26.669	26.788	.....
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver: London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	.....	64.76	.....	69.170	.....
April	14.211	.....	64.747	.....	69.313	.....
May	13.996	.....	63.182	.....	67.786	.....
June	13.603	.....	61.336	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	.....	.....	.....	.....	.....	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	.....	173.619	.....
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	159.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	.....	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	.....	3.850	.....	19.651	.....
April	3.810	.....	3.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.503	.....
June	3.900	.....	3.810	.....	19.411	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	.....	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	.....	5.100	.....	21.460	.....
April	5.113	.....	4.96	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.06	.....	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.43	$13.99	$13.90
February	15.06	14.55	14.12	13.43	14.08	13.90
March	15.07	.....	13.94	.....	14.10	.....
April	14.90	.....	13.9	.....	14.13	.....
May	4.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13.97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....